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INSTITUTO DE CIÊNCIAS BIOMÉDICAS ABEL SALAZAR
UNIVERSIDADE DO PORTO

PRESSURE ULCER (RISK) ASSESSMENT: CLINICAL NURSING RESEARCH

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Tese de Doutoramento em Ciências de Enfermagem

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PEDRO MIGUEL GARCEZ SARDO

PRESSURE ULCER (RISK) ASSESSMENT: CLINICAL NURSING RESEARCH

Tese de Candidatura ao grau de Doutor em Ciências de Enfermagem, submetida ao Instituto de Ciências Biomédicas Abel Salazar da Universidade do Porto.

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Pressure ulcers continue to be a challenge to all health care professionals and institutions and preventive strategies should (still) be discussed in a multidisciplinary way in order to improve patients' outcomes

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To all those who understood my “absences” during the development of this project ...

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To all those who directly (or indirectly) contributed to conceive, design, implement, evaluate and divulgate this project…

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RESUMO

Introdução: As úlceras por pressão são um desafio para os profissionais e instituições e representam um indicador de qualidade em saúde. As diretrizes nacionais e internacionais fornecem orientações sobre as "leges artis" da gestão das úlceras por pressão e importantes recomendações para a prática e para a pesquisa clínica. Embora não exista a evidência de que o uso de escalas de avaliação do risco de úlcera por pressão reduzam a incidência de úlceras por si só, atualmente são utilizadas várias escalas na prática clínica. A Escala de Braden demonstrou a melhor fiabilidade e validade em vários contextos de prestação de cuidados e a sua utilização pode auxiliar os enfermeiros na implementação de intervenções preventivas. Existem vários estudos sobre o risco, a prevalência e/ou a incidência de úlceras por pressão. No entanto ainda existe uma lacuna de conhecimento sobre a dimensão do problema das úlceras por pressão nas pessoas hospitalizadas nos serviços da área médica e cirúrgica; sobre as características das pessoas que têm e/ou desenvolveram úlceras por pressão durante o internamento; e sobre a influência das dimensões da Escala de Braden no desenvolvimento de úlceras por pressão. **Objetivo:** Conhecer a magnitude do problema das úlceras por pressão em pessoas internadas num hospital português. **Metodologia:** Estudo de coorte retrospetivo com análise da base de dados do processo electrónico das pessoas internadas num hospital português durante o ano de 2012. O estudo foi dividido em várias etapas com objetivos e critérios de inclusão e exclusão específicos (explicados em cada capítulo). Foi aprovado pelo Conselho de Administração e pelo Comitê de Ética do hospital. Os dados foram analisados através do "SPSS" 21.0 e 23.0. Foram utilizadas medidas de estatística descritiva para a caracterização da amostra e das variáveis demográficas e clínicas. O risco de desenvolvimento de úlceras por pressão foi calculado de acordo com as orientações da Direção-Geral da Saúde. As taxas de prevalência e de incidência foram calculadas de acordo com as orientações do "European Pressure Ulcer Advisory Panel". O "odds ratio" foi calculado através de regressão logística univariada para cada variável de interesse. O "hazard ratio" foi calculado através da regressão de Cox univariada para cada variável de interesse e através da regressão de Cox multivariada para as dimensões da Escala de Braden que foram estatisticamente significativas. Foram realizados testes de acurácia da Escala de Braden. Em todas as análises um "p-value"<0.05 indicou significância estatística.

Resultados: O estudo sobre a avaliação do risco de desenvolvimento de úlceras por pressão (capítulo 1) incluiu uma amostra de 8147 participantes onde 34.4% apresentavam alto risco de desenvolvimento de úlceras por pressão na primeira avaliação nos serviços de internamento. A percentagem de participantes com risco diminuiu significativamente na última avaliação quando comparado com a primeira avaliação. No entanto, no momento da alta para o exterior, 14.0% dos participantes ainda apresentavam alto risco de desenvolvimento de úlceras por pressão. O estudo sobre a prevalência de úlceras por pressão (capítulo 2) incluiu uma amostra de 7132 participantes e registou um ponto de prevalência de 7.9% participantes com úlcera por pressão na primeira avaliação nos serviços de internamento. Foram documentadas 1455 úlceras por pressão na primeira avaliação. A maioria das úlceras registadas eram categoria I (42.3%). Os calcanhares (28.9%) e o sacro/cóccix (22.4%) foram as áreas mais afetadas. Registou-se um rácio de 2.60 úlceras por pressão por participante com úlcera. O estudo sobre a incidência de úlceras por pressão (capítulo 3) incluiu uma amostra de 7132 participantes e registou um período de prevalência de 10.0% participantes com úlcera por pressão durante o ano de 2012 e uma incidência cumulativa de 3.4% participantes com úlcera por pressão durante o mesmo período. Foram registadas 320 novas úlceras por pressão durante o internamento. A maior parte das novas úlceras eram categoria II (43.8%). O sacro/cóccix (35.6%) e os trocânteres (17.7%) foram as áreas mais afetadas. Registou-se um rácio de 1.33 úlceras por pressão nos participantes que desenvolveram uma nova úlcera. Um dos maiores fatores de risco para o desenvolvimento de uma úlcera por pressão durante o internamento foi a presença prévia de uma úlcera por pressão no momento da admissão. No ano de 2012 foram documentadas 1775 úlceras por pressão. A maioria das úlceras registadas eram categoria I (39.9%). Os calcanhares (25.9%), o sacro/cóccix (24.8%) e os trocânteres (13.7%) foram as áreas mais afetadas. Registou-se um rácio de 2.49 úlceras por pressão em participantes com úlceras por pressão. O estudo sobre o desenvolvimento da primeira úlcera por pressão durante o internamento (capítulo 4) incluiu uma amostra de 6572 participantes e destacou as características dos 157 participantes (2.3%) que desenvolveram a sua primeira úlcera no internamento. Para 80 desses participantes (52.3%) esse evento crítico ocorreu na primeira semana, atingindo a maior frequência (27 participantes) ao 5º dia de internamento.

O estudo sobre a influência das dimensões da Escala de Braden no desenvolvimento de úlcera(s) por pressão (capítulo 5) incluiu uma amostra de 6552 participantes e revelou que quanto menor o resultado total da Escala de Braden maior o "hazard ratio" de desenvolvimento de úlcera(s) por pressão. Os testes de acurácia da Escala de Braden mostraram uma sensibilidade de 63.4% (IC 95%: 55.2%-71.0%), uma especificidade de 73.8% (IC 95%: 72.7%-74.9%) e uma área sob a curva de 0.69 (IC 95%: 0.64-0.73). A análise multivariada mostrou que a (i)“mobilidade” foi o principal fator de risco (avaliado através da Escala de Braden) para o desenvolvimento de úlcera(s) por pressão. No último estudo (capítulo 6) foram analisados e discutidos vários temas relacionados com o problema das úlceras por pressão tendo em consideração os resultados dos estudos anteriores, a evidência científica nacional e internacional e a nossa prática clínica. Em todos os capítulos foi destacado que existem importantes fatores de risco que não são avaliados pela Escala de Braden (como a idade, a causa e o tipo de admissão, a duração do internamento e a presença prévia de uma úlcera por pressão) que devem ser considerados pelos enfermeiros quando planeiam e prestam cuidados. **Conclusão:** Aproximadamente um terço de todos os participantes apresentaram alto risco de desenvolvimento de úlceras por pressão na primeira avaliação. Os resultados totais da Escala de Braden aumentaram significativamente na última avaliação, mostrando que esta escala foi sensível às alterações clínicas dos participantes. Embora as taxas de prevalência e incidência tenham sido inferiores às reportadas em estudos nacionais anteriores, seguem a tendência atual dos estudos internacionais. A presença de uma úlcera por pressão na primeira avaliação pode ser uma importante medida de fragilidade. Os participantes com úlcera por pressão normalmente apresentavam mais do que uma úlcera e maiores probabilidades de desenvolverem uma nova durante o internamento. A primeira semana de internamento foi um período crítico para o desenvolvimento de úlceras por pressão. A falta de capacidade para alterar e controlar a posição corporal foi o principal fator de risco para o desenvolvimento de úlceras por pressão independentemente do resultado total da Escala de Braden. O conhecimento da existência de fatores de risco modificáveis e não modificáveis (assim como a influência das várias dimensões da Escala de Braden) pode contribuir para melhorar os cuidados e os resultados de enfermagem.

Palavras-chave: Avaliação em Enfermagem; Enfermagem; Escala de Braden, Fatores de Risco; Incidência; Medição de Risco; Portugal; Prevalência; Úlcera por pressão.

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ABSTRACT

Introduction: Pressure ulcers continue to be a challenge to healthcare professionals and institutions and represent an indicator of healthcare quality. National and international guidelines give orientations about the “leges artis” on pressure ulcer management and provide important recommendations for clinical practice and clinical research. Although there is no evidence that the use of pressure ulcer risk assessment scales reduce the incidence of pressure ulcers by itself, today several risk assessment scales are used in clinical practice. The Braden Scale has demonstrated the best reliability and validity in a variety of care settings and their usage should support nurses in the implementation of preventive interventions. There are several studies on pressure ulcer risk, prevalence and/or incidence developed in different care settings. Nevertheless, there is a lack of knowledge on pressure ulcers problem dimension in medical and surgical wards; on the characteristics of the patients who had and/or developed pressure ulcers during the length of inpatient stay; and on the influence of the Braden subscale scores on pressure ulcer development. **Aim:** To gain more insight into the magnitude of pressure ulcers problem in general wards of a Portuguese hospital. **Methodology:** Retrospective cohort analysis of electronic health record database from adult patients admitted to medical and surgical wards in a Portuguese hospital during 2012. The study was divided in several tasks with specific aims and inclusion and exclusion criteria (described in each chapter). The study was performed after Hospital Council Board and Ethics Committee approval. Data was analysed using the SPSS 21.0 and 23.0. Descriptive statistics were calculated for the sample characterisation, the demographic and clinical variables. Pressure ulcer risk was calculated according to “Direção-Geral da Saúde” orientations. Prevalence and incidence of the participants with pressure ulcers were calculated according to European Pressure Ulcer Advisory Panel orientations. The odds ratio was calculated by univariate logistic regression for each variable of interest. The hazard ratio was calculated by univariate Cox regression for each variable of interest and by multivariate Cox regression for the Braden subscales that were statistically significant. Braden Scale accuracy tests were assessed. In all analyses a p-value<0.05 indicated statistical significance.

Results: The study on pressure ulcer risk assessment (chapter 1) included a sample of 8147 participants where 34.4% had high risk of pressure ulcer development at the first assessment in inpatient setting. The percentage of participants with high risk of pressure ulcer development significantly decreased in the last assessment when compared with the first one. However, at the time of patient discharge, 14.0% of the participants still had high risk of pressure ulcer development. The study on pressure ulcer (point) prevalence (chapter 2) included a sample of 7132 participants and reported a point prevalence of 7.9% participants with pressure ulcer at the first skin and tissue assessment in inpatient setting. At admission 1455 pressure ulcers were documented. Most of the pressure ulcers recorded were category/stage I (42.3%). The heels (28.9%) and the sacrum/coccyx (22.4%) were the most critical areas. There was a ratio of pressure ulcers per participant with pressure ulcer of 2.60. The study on pressure ulcer incidence (chapter 3) included a sample of 7132 participants and reported a period prevalence of 10.0% participants with pressure ulcer in inpatient setting during 2012 and a cumulative incidence of 3.4% participants with pressure ulcer in inpatient setting in the same period. During the length of stay, 320 new pressure ulcers were documented. Most of the new pressure ulcers recorded were category/stage II (43.8%). The sacrum/coccyx (35.6%) and the trochanters (17.7%) were the most critical areas. There was a ratio of pressure ulcers per participant that developed a new pressure ulcer of 1.33. One of the biggest risk factors for pressure ulcer development during the length of inpatient stay was the presence of a previous pressure ulcer at the time of admission. In 2012, 1775 pressure ulcers were documented. Most of the pressure ulcers recorded were category/stage I (39.9%). The heels (25.9%), the sacrum/coccyx (24.8%) and the trochanters (13.7%) were the most problematic areas. There was a ratio of pressure ulcers per participant with pressure ulcer of 2.49. The study on the development of the first pressure ulcer (chapter 4) included a sample of 6572 participants and highlighted the characteristics of 157 participants (2.3%) that developed their first pressure ulcer during the length of stay. For 80 of those participants (52.3%) that critical event occurred during the first week, with higher frequency (27 participants) at day 5 of inpatient stay.

The study on the influence of Braden subscales on pressure ulcer development (chapter 5) included a sample of 6552 participants and demonstrated that as the total Braden Scale scores decreased, there was a statistically significant increase on the hazard ratio of pressure ulcer(s) development. Our Braden Scale accuracy tests showed a sensitivity of 63.4% (CI 95%: 55.2%-71.0%), a specificity of 73.8% (CI 95%: 72.7%-74.9%) and an area under the curve of 0.69 (CI 95%: 0.64-0.73). The multivariate time to event analysis showed that (im)"mobility" was the major risk factor (assessed through Braden Scale) for pressure ulcer development. In the last study (chapter 6) several issues related to the pressure ulcers problem were analysed and discussed taking into account the results of previous studies, national and international scientific evidence and our clinical practice. In all chapters it was highlighted that there are important pressure ulcer risk factors not assessed by Braden Scale (such as age, the cause and type of admission, the length of inpatient stay and the presence of a pressure ulcer) that should be considered by nurses when they plan and deliver care. **Conclusion:** Approximately one third of all participants had high risk of pressure ulcer development at admission. The Braden Scale scores significantly increased in the last assessments showing that Braden Scale was sensitive to patient clinical changes. Although the prevalence and incidence rates were lower than the ones reported in previous national surveys, they followed the trend of current international studies. The presence of a pressure ulcer at the first skin and tissue assessment could be an important measure of frailty. The participants with pressure ulcer commonly had more than one documented pressure ulcer and highest odds of developing a new one during the length of inpatient stay. The first week of inpatient stay was a critical period for the development of pressure ulcer(s). The lack of ability to change and control body position was the major risk factor for pressure ulcer development during the length of stay independently of the total Braden Scale score. The awareness of the existence of modifiable and non-modifiable risk factors (and the influence of each Braden subscale) could contribute to improve nursing care and patients' outcomes.

Keywords: Braden Scale, Incidence; Nursing; Nursing Assessment; Portugal; Pressure Ulcer; Prevalence; Risk Assessment; Risk Factors.

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ABREVIATIONS AND ACRONYMS

APTFeridas – Associação Portuguesa de Tratamento de Feridas

BMC – BioMed Central

BS – Braden Scale

BWAT – Bates-Jensen Wound Assessment Tool

CHBV – Centro Hospitalar do Baixo Vouga

CINTESIS – Center for Health Technology and Services Research

CNS – Clinical Nurse Specialist

ELCOS – ELCOS, Sociedade Portuguesa de Feridas

EPUAP – European Pressure Ulcer Advisory Panel

ESENFC – Escola Superior de Enfermagem de Coimbra

ESEP – Escola Superior de Enfermagem do Porto

ESSUA – Escola Superior de Saúde da Universidade de Aveiro

EWMA – European Wound Management Association

GAIF – Grupo Associativo de Investigação em Feridas

GEHUPP – Grupo de Estudio de Heridas y Úlceras por Presión

HR – Hazard Ratio

ICBAS – Instituto de Ciências Biomédicas Abel Salazar

ICU – Intensive Care Unit(s)

IPLeiria – Instituto Politécnico de Leiria

JCN – Journal of Clinical Nursing

JTV – Journal of Tissue Viability

MNSc – Master in Nursing Sciences

NPUAP – National Pressure Ulcer Advisory Panel

OR – Odds Ratio

PPPIA – Pan Pacific Pressure Injury Alliance

PSST – Pressure Sore Status Tool

PU – Pressure Ulcer(s)

PUSH – Pressure Ulcer Scale for Healing

RN – Registered Nurse

SAT – Skin Assessment Tool

SILAUHE – Sociedad Iberolatinoamericana Úlceras y Heridas

SP – Standard Deviation

TVS – Tissue Viability Society

TABLE OF CONTENTS

LIST OF FIGURES

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LIST OF TABLES

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AWARDS IN SCIENTIFIC EVENTS

3rd Award
Oral Presentation
APTFeridas 2013 / 15º Aniversário

Sardo, P., Simões, C., Alvarelhão, J., Simões, J.,Melo, E. (2013). Caraterização do Perfil dos Doentes com Risco de Desenvolvimento de Úlceras de Pressão. Congresso APTFeridas 2013 / 15º Aniversário, Porto, Portugal.

3rd Award
Oral Presentation
Congresso APTFeridas 2014 / Infeção e Qualidade

Sardo, P., Simões, C., Alvarelhão, J., Simões, J.,Melo, E. (2014). Análise da prevalência, incidência, localização e categoria das úlceras de pressão. Congresso APTFeridas 2014 / Infeção e Qualidade, Porto, Portugal.

1st Award
Oral Presentation
Simpósio APTFeridas 2015 / Investigação e Inovação em Feridas

Sardo, P., Simões, J., Machado, P., Melo, E. (2015). Úlceras de pressão: Analisar o passado para planear o futuro. Simpósio APTFeridas 2015 / Investigação e Inovação em Feridas, Porto, Portugal.

1ST Award
Oral Presentation
Congresso APTFeridas 2016 / Avaliar, Prevenir, Tratar, Feridas

Sardo, P., Guedes, J., Alvarelhão, J., Machado, P., Melo, E. (2016). A influência das dimensões da Escala de Braden no desenvolvimento de úlceras de pressão. Congresso APTFeridas 2016, Porto, Portugal.

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GENERAL INTRODUCTION

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GENERAL INTRODUCTION

Pressure ulcers continue to be a challenge worldwide (Coleman, Nelson, et al., 2014; Coleman, Nixon, et al., 2014; Coleman, Smith, Nixon, Wilson, & Brown, 2016; NPUAP, EPUAP, & PPPIA, 2014; Smith, Nixon, Brown, Wilson, & Coleman, 2016) **and represent an indicator of healthcare quality** (Dealey et al., 2012; Hopkins, 2012; Moore, Cowman, & Posnett, 2013; Silva et al., 2013).

Nowadays there are several studies on **pressure ulcer risk assessment** (Chou et al., 2013; Pancorbo-Hidalgo, Garcia-Fernandez, Lopez-Medina, & Alvarez-Nieto, 2006; Papanikolaou, Lyne, & Anthony, 2007; Sharp & McLaws, 2006; Stechmiller et al., 2008), **pressure ulcer prevalence** (Amir, Meijers, & Halfens, 2011; Bredesen, Bjoro, Gunningberg, & Hofoss, 2015; Gallagher et al., 2008; Kottner, Wilborn, Dassen, & Lahmann, 2009; Mehta, George, Mehta, & Wangmo, 2015; Moore & Cowman, 2012; Schoonhoven, Bousema, & Buskens, 2007; Stevenson et al., 2013; Tubaishat, Anthony, & Saleh, 2011; Vanderwee, Clark, Dealey, Gunningberg, & Defloor, 2007), **pressure ulcer incidence** (Campanili, Santos, Strazzieri-Pulido, Thomaz, & Nogueira, 2015; Cox, 2011; Cremasco, Wenzel, Zanei, & Whitaker, 2013; Dugaret et al., 2014; Igarashi et al., 2013; Jenkins & O'Neal, 2010; Kwong, Pang, Aboo, & Law, 2009; Manzano et al., 2010; Schoonhoven et al., 2007; Tescher, Branda, Byrne, & Naessens, 2012) developed in different countries and in different care settings. **However, data about Portuguese reality and/or general wards are still few**.

Other authors studied the **impact of length of stay** (Campanili et al., 2015; Cox, 2011; Cremasco et al., 2013; Schoonhoven et al., 2007; Theisen, Drabik, & Stock, 2012) and the **influence of Braden subscales** (Cox, 2011; Menegon et al., 2012; Tescher et al., 2012) on pressure ulcer development, **nevertheless the results were limited and the findings inconclusive**.

According to international guidelines (NPUAP et al., 2014) “A **pressure ulcer** is a localized injury to the skin and/or underlying tissue usually over a bony prominence, as a result of pressure, or pressure in combination with shear. A number of contributing or confounding factors are also associated with pressure ulcers; the significance of these factors is yet to be elucidated.”

During the last years, European Pressure Ulcer Advisory Panel (EPUAP) and National Pressure Ulcer Advisory Panel (NPUAP) have developed a common international definition

and classification system for pressure ulcers (EPUAP & NPUAP, 2009a, 2009b). They state that the concepts “staging” or “grading” implies a progression (from I to IV), but that is not always the case. So, “category” was suggested as a neutral term to replace “stage” or “grade” because it has the advantage of being a non-hierarchical designation, allowing us to free ourselves from the mistaken notions of “progressing from I to IV” and “healing from IV to I” (EPUAP & NPUAP, 2009a, 2009b).

Nowadays, the International NPUAP/EPUAP Pressure Ulcer Classification System (NPUAP et al., 2014) is composed by: Non-blanchable erythema (Category/Stage I), Partial thickness (Category/Stage II), Full thickness skin loss (Category/Stage III), Full thickness tissue loss (Category/Stage IV) and Depth unknown (Unstageable and Suspect depth tissue injury).

Non-blanchable erythema (Category/Stage I): Intact skin with non-blanchable redness of a localized area usually over a bony prominence. Darkly pigmented skin may not have visible blanching; its colour may differ from the surrounding area. The area may be painful, firm, soft, warmer or cooler as compared to adjacent tissue. Category/Stage I may be difficult to detect in individuals with dark skin tones (NPUAP et al., 2014).

Partial thickness (Category/Stage II): Partial thickness loss of dermis may present a shallow open ulcer with a red pink wound bed, without slough. It may also present an intact or open/ruptured serum-filled as well as a shiny or dry shallow ulcer without slough or bruising (bruising indicates suspected deep tissue injury). This Category/Stage should not be used to describe skin tears, tape burns, perineal dermatitis, maceration or excoriation (NPUAP et al., 2014).

Full thickness skin loss (Category/Stage III): Full thickness tissue loss. Subcutaneous fat may be visible but bone, tendon or muscle are not exposed. Slough may be presented but does not obscure the depth of tissue loss. It may include undermining and tunneling. The depth of a Category/Stage III pressure ulcer varies by anatomical location. The bridge of the nose, ear, occiput and malleolus do not have subcutaneous tissue and Category/Stage III ulcers can be shallow. In contrast, areas of significant adiposity can develop extremely deep Category/Stage III pressure ulcers. Bone/tendon is not visible or directly palpable (NPUAP et al., 2014).

Full thickness tissue loss (Category/Stage IV): Full thickness tissue loss with exposed bone, tendon or muscle. Slough or eschar may be presented on some parts of the wound. Often includes undermining and tunnelling. The depth of a Category/Stage IV pressure ulcer varies by anatomical location. The bridge of the nose, ear, occiput and malleolus do not have subcutaneous tissue and these ulcers can be shallow. Category/Stage IV ulcers can extend

into muscle and/or supporting structures (e.g., fascia, tendon or joint capsule) making osteomyelitis possible. Exposed bone/muscle is visible or directly palpable" (NPUAP et al., 2014).

Depth Unknown (Unstageable): Full thickness tissue loss whose wound bed is covered by slough (yellow, tan, gray, green or brown) and/or by eschar (tan, brown or black). Until enough slough and/or eschar is removed to expose the base of the wound, the true depth, and therefore Category/Stage, cannot be determined (NPUAP et al., 2014).

Depth Unknown (Suspected Deep Tissue Injury): Purple or maroon localized area of discoloured intact skin or blood-filled blister due to damage of underlying soft tissue from pressure and/or shear. The area may be preceded by tissue that is painful, firm, mushy, boggy, warmer or cooler compared to adjacent tissue. Deep tissue injury may be difficult to detect in individuals with dark skin tones. Evolution may include a thin blister over a dark wound bed. The wound may further evolve and become covered by thin eschar. The wound evolution may be rapid, exposing additional layers of tissue even with optimal treatment (NPUAP et al., 2014).

Recently (NPUAP, 2016) announces changes in terminology from "pressure ulcer" to "pressure injury" and updates the stages of existent pressure injuries. However, this new terminology was not applied in our study reports.

Pressure ulcers are a serious health problem especially among older care dependent people (Ferreira, Miguéns, Gouveia, & Furtado, 2007; Kottner, Wilborn, et al., 2009; Kwong et al., 2009) and **the first step in pressure ulcer prevention is the identification of individual risks** (EPUAP & NPUAP, 2009a, 2009b; Ferreira et al., 2007; Kottner & Dassen, 2008a; NPUAP et al., 2014; Vanderwee et al., 2011).

In fact, effective pressure ulcer prevention depends on health care professionals (especially nurses) that **identify patients who are particularly vulnerable to pressure damage due to their specific risk factors** (Dealey et al., 2013; NPUAP et al., 2014) in order to implement **specific preventive measures** (Keller, Wille, van Ramshorst, & van der Werken, 2002; Pancorbo-Hidalgo et al., 2006; Stechmiller et al., 2008).

A variety of pressure ulcer risk assessment scales has been developed (Anthony, Parboteeah, Saleh, & Papanikolaou, 2008; Papanikolaou et al., 2007) since the creation of Norton scale in early 1960s (Norton, McLaren, & Exton-Smith, 1962).

Although there is no evidence that the use of pressure ulcer risk assessment scales reduce the incidence of pressure ulcers by itself (Anthony et al., 2008; Chou et al., 2013;

Pancorbo-Hidalgo et al., 2006), today more than 30 risk assessment scales are known worldwide and are used in clinical practice (Defloor & Grypdonck, 2004, 2005; Kottner, Hauss, Schluer, & Dassen, 2013).

Some authors (Anthony et al., 2008; Pancorbo-Hidalgo et al., 2006; Papanikolaou et al., 2007) critically review the most commonly used pressure ulcer risk instruments: the Norton scale; the Waterlow scale and the Braden scale.

In 2006, a systematic review of various studies published in Spanish, English, French and Portuguese, compared the three scales to determine which of them demonstrated the best reliability and validity (Pancorbo-Hidalgo et al., 2006). They concluded that the **Braden Scale had been tested in the largest number of studies, and had demonstrated the best reliability and validity indicators in a variety of settings** (Pancorbo-Hidalgo et al., 2006).

Nowadays there are several studies around the world using the Braden Scale in different care settings, like nursing homes (Kottner & Dassen, 2008b; Kottner, Dassen, & Lahmann, 2010; Lahmann, Tannen, Dassen, & Kottner, 2011), general hospitals (Ferreira et al., 2007; Vanderwee, Clark, et al., 2007), intensive care units (ICU) (Kottner & Dassen, 2010; Shahin, Dassen, & Halfens, 2009; Tescher et al., 2012), home care settings (Bergquist, 2001; Bergquist & Frantz, 2001; Kottner, Halfens, & Dassen, 2009) and paediatric services (Anthony, Willock, & Baharestani, 2010; Kottner et al., 2013).

International guidelines (EPUAP & NPUAP, 2009a, 2009b; NPUAP et al., 2014) state that risk assessment should be done using a validated tool (like Braden Scale) at the admission and should be reassessed if there is any change in the patient's condition.

Portuguese guidelines (DGS, 2011) encourage the implementation of regular pressure ulcer risk assessments through the application of the Braden Scale. That assessment should be performed every 24 hours in emergency services and intensive care units. In inpatient settings that assessment should be performed at admission and repeated every 48 hours during the length of stay. It also recommends the patients' categorization into two levels of risk, defined by cut-off point of 16, which determines the implementation of preventive interventions.

The Braden Scale score ranges from 6 to 23 and is composed by 6 subscales: "sensory perception", "moisture", "activity", "mobility", "nutrition" and "friction/shear forces". Each subscale is rated 1 to 4, except for "friction/shear forces", which is rated 1 to 3 (the smallest value corresponds to a higher risk of developing pressure ulcers). The total score is used to predict overall risk of pressure ulcer development (Bergstrom, 2002; Bergstrom, Braden, Kemp, Champagne, & Ruby, 1998; Bergstrom, Braden, Laguzza, & Holman, 1987).

The Braden Scale was translated and validated for the Portuguese population by "Centro de Estudos e Investigação em Saúde da Universidade de Coimbra" (CEISUC) in 2001 and was known as **"Escala de Braden para avaliação do risco de úlceras de pressão"** (Attach 1).

Following Portuguese guidelines (DGS, 2011) **"Centro Hospitalar Baixo Vouga, EPE – Unidade de Aveiro" (CHBV) adopted the Braden Scale to identify patients at risk of developing pressure ulcers**, and the assessments are performed only in inpatient settings at admission and repeated every 48 hours. Thus, patients with an evaluation of the Braden Scale score ≤ 16 have a high risk of developing pressure ulcers, and patients with a Braden Scale score evaluation > 16 have a lower risk of developing pressure ulcers. Although the pressure ulcer risk assessment is performed in a systematic way there is no formal protocol related to the implementation of preventive measures. Thus, nursing staff uses powered device in bed (like alternating pressure mattress), non-powered device in bed (like pressure relief mattress), powered device in chair (alternating pressure pillow), non-powered device in chair (like pressure relief pillow) and/or repositioning every 2, 3 or 4 hours in a subjective way.

According to **international guidelines** (NPUAP et al., 2014) **the skin and tissue assessment** is an important step in pressure ulcer prevention, classification, diagnosis and treatment.

A comprehensive skin and tissue assessment should be performed in all health care settings, and should include techniques to identify blanching response, temperature changes, oedema and changes in tissue consistency in relation to surrounding tissue (NPUAP et al., 2014).

The skin under and around medical devices should be inspected at least twice daily for the signs of pressure-related injury on the surrounding tissue (NPUAP et al., 2014).

Portuguese guidelines (DGS, 2011) encourage the implementation of regular skin and tissue assessments through the application of a skin assessment tool named **"Instrumento da Avaliação da Pele"** (Attach 2) that allows the identification/recording of skin integrity or the presence of pressure ulcer(s), their localization (body chart with 29 possible areas), size, depth and category/stage. That assessment should be performed every 24 hours in emergency services and intensive care units. In inpatient settings that assessment should be performed at admission and repeated every 48 hours during the length of stay.

Following Portuguese guidelines (DGS, 2011) **CHBV adopted the "Instrumento da Avaliação da Pele" (skin assessment tool) to perform (and record) the skin and tissue assessment**. The evaluations are performed (only) in inpatient settings at admission and

repeated every 48 hours. Although the skin and tissue assessment is performed in a systematic way there is no validated assessment tool to record pressure ulcer characteristics and their evolution during the length of stay.

As we said previously, **pressure ulcers are an indicator of healthcare quality** (Dealey et al., 2012; Hopkins, 2012; Moore et al., 2013; Silva et al., 2013) and this information is typically provided through measurements of pressure ulcer rates, especially **prevalence** and **incidence** (Berlowitz, 2014; Defloor et al., 2005). However, estimates of pressure ulcer prevalence (number of patients with pressure ulcers within a particular population) and incidence (the rate at which new pressure ulcers are occurring) vary according to care setting or population studied, pressure ulcer category/stage and methodologies used (Dugaret et al., 2014).

In fact, prevalence and incidence are used to measure disease frequency. Both have been used to record the number of people with pressure ulcers. **However they provide different perspectives on the magnitude of the pressure ulcers problem** (Defloor et al., 2005).

Following EPUAP statement (Defloor et al., 2005) **pressure ulcer point prevalence** was calculated as: [(number of participants with a pressure ulcer / number of participants in a population at a particular point of time) x 100]; **pressure ulcer period prevalence** was calculated as: [(number of participants with a pressure ulcer / number of participants in a population during a particular period of time) x 100]; and **pressure ulcer cumulative incidence** was calculated as: [(number of participants developing new pressure ulcers / number of participants (with or without pressure ulcers) in the population during the data collection period) x 100].

A multicentre study with 5947 patients admitted to 25 hospitals in five **European countries** (Belgium, Italy, Portugal, Sweden and the UK) indicated a **prevalence of pressure ulcers (Category/Stage I to IV) of 18.1%** and a prevalence of pressure ulcers (Category/Stage II to IV) of 10.5%. The sacrum and heels were identified as the most affected areas with 28.6% and 26% of the pressure ulcers identified (Vanderwee, Clark, et al., 2007). Considering pressure ulcer risk assessment, 35.5% of patients had a Braden Scale score ≤ 16, and only 9.7% of these received all the appropriate preventive care (Vanderwee, Clark, et al., 2007).

In **Portugal**, there are few published studies on the incidence and prevalence of pressure ulcers. A multicentre study (Ferreira et al., 2007) developed with 10202 inpatients in 8 Portuguese hospitals showed an overall **pressure ulcer prevalence rate (Category/Stage I to IV) of 11.5%**, with higher prevalence in medical services (17.4%), followed by medical specialties (8%) and surgical specialties (7.1%).

Other study (Vanderwee, Clark, et al., 2007) with a sample of 786 inpatients in 3 Portuguese general hospitals, pointed to a **prevalence of pressure ulcers (Category/Stage I to IV) of 12.5%** and a prevalence of pressure ulcers (Category/Stage II to IV) of 9.5%. The most affected areas were the heels, with 27.7% of pressure ulcers, and the sacrum region with 21.9% of pressure ulcers identified. Regarding pressure ulcer risk assessment, 30.8% of patients had a Braden Scale score ≤ 16, and only 1.6% of them received all the appropriate preventive care.

These studies (Ferreira et al., 2007; Vanderwee, Clark, et al., 2007) highlighted the prevalence, category/stage and localisation of pressure ulcers in hospitalised adult patients. **However, more studies are needed to know the characteristics of those who have and/or developed pressure ulcers during the length of stay and the characteristics of pressure ulcers itself**.

Being admitted to a nursing home or a hospital is an important measure of frailty (Deandrea et al., 2013; Sardo, Simões, Alvarelhão, Simões, & Melo, 2016) and a prolonged length of stay is a significant predictor of functional decline during the hospitalisation (Hoogerduijn, Schuurmans, Duijnstee, de Rooij, & Grypdonck, 2007).

According to Theisen et al. (2012) the prevalence and/or incidence of pressure ulcers in elderly patients in a German hospital are an independent and significant predictor of a prolonged length of inpatient stay.

A study developed by Schoonhoven et al. (2007) in two Netherland hospitals showed that a considerable percentage of patients develop pressure ulcers during the first week of hospitalisation. Therefore, the period directly following admission should be considered critical for implementation of nursing preventive measures. Moreover, the high incidence of pressure ulcers in surgical patients suggests that prevention strategies should also be aimed at the perioperative period.

Other studies performed in intensive care units in USA (Cox, 2011) and in Brazil (Cremasco et al., 2013) also reported that the most vulnerable time for development of pressure ulcer(s) during the length of stay was the first week, and highlighted that **the first week of stay should be a period of higher vigilance for pressure ulcer risk** (Cox, 2011).

For Campanili et al. (2015) the major risk factor for pressure ulcer development was length of stay for 9.5 days or more.

However, more studies are needed to better understand the correlation between pressure ulcer incidence and the length of stay.

The **development of pressure ulcer(s) is complex and multifactorial** (Cox, 2011) and nursing staff needs to manage **several pressure ulcer risk factors** (Coleman, Nelson, et al., 2014; Coleman, Nixon, et al., 2014) in order to prevent pressure ulcer development in inpatient settings.

Despite the systematic pressure ulcer risk assessment and the systematic skin and tissue assessment, **preventive measures are not always effectively implemented** (Gallagher et al., 2008; Vanderwee, Clark, et al., 2007) and the prevalence and/or incidence of pressure ulcers in hospitals is still high (Beeckman, Defloor, Schoonhoven, & Vanderwee, 2011; Vanderwee, Grypdonck, & Defloor, 2007). Furthermore, due to the **limited predictive power of the risk assessment tools,** many patients categorised as "at risk" do not develop pressure ulcer(s) (even when the preventive measures are omitted) and a considerable number of patients categorized as "not at risk" do develop pressure ulcer(s) (Vanderwee, Grypdonck, et al., 2007).

The Braden Scale has been found to have better predictive validity than nursing judgment on its own, which depends on nursing experience (Pancorbo-Hidalgo et al., 2006). However, **the best care is prescribed when the Braden Scale is used in conjunction with proper nursing judgment** (Braden, 2012). In fact, a good nursing judgment would reveal other patients' characteristics and/or patients' risk factors not measured by the Braden Scale and the need of specific preventive interventions (Braden, 2012). Consequently, when risk assessment is supplemented with nursing judgment, proper preventive measures and accurate nursing interventions, it is reasonable to expect that the incidence of full-thickness pressure ulcers will decrease (Braden, 2012; Comfort, 2008; Lynn et al., 2007).

On the other hand, Braden (2012) recommends that **nurses should use each Braden subscale score as an initial appraisal of patient's specific problems and functional deficits**, as a flag for assessments that need to be further explored, and as a guide to the preventive interventions required. **However, the investigation of the contribution of the Braden subscale scores has been limited and the findings have been inconclusive** (Cox, 2011; Tescher et al., 2012).

During the last years, I have been developing my clinical practice at Aveiro Hospital and I realised that the patients admitted to inpatient setting were aging and presenting important risk factors for pressure ulcer development.

In 2013, University of Aveiro and Aveiro Hospital started a multidisciplinary research project, in which I am involved, dedicated to the epidemiological assessment of the patients with different wounds of different aetiologies.

This Thesis presented to "Instituto de Ciências Biomédias Abel Salazar" of Oporto University is (just) one step of the larger project that was approved by the Hospital Council Board and Ethics Committee (Attach 3).

Taking all this in account, **the main aim of this study was to gain more insight into the magnitude of the problem of pressure ulcers in general wards in a Portuguese hospital.**

In order to accomplish this goal, this Thesis was structured in **6 chapters**, each one with a different "point of view" of the magnitude of pressure ulcers problem.

On **Chapter 1** we were focused on **Pressure Ulcer Risk Assessment** and we presented an original article that aimed to analyse the Braden Scale scores in hospitalised patients in association with their characteristics, diagnoses and length of inpatient stay.

On **Chapter 2** we were focused on **Pressure Ulcer (Point) Prevalence** and we presented an original article that aimed to take a photograph of the first skin and tissue assessment in inpatient setting, highlighting the patients' characteristics.

On **Chapter 3** we were focused on **Pressure Ulcer Incidence** and we presented an original article that aimed to take a photograph about what happened during the length of stay as far as pressure ulcer development is concerned, highlighting the patients' characteristics.

On **Chapter 4** we were focused on the **development of the first pressure ulcer** and presented 2 papers published on the proceedings of an international conference. The first one analysed the incidence of the participants that developed their first pressure ulcer during the length of inpatient stay in association with their demographic and clinical characteristics. The second one identified the day of the first pressure ulcer development in inpatient setting.

On **Chapter 5** we were focused on **Braden subscales** and we presented an original article that aimed to determine which Braden subscales are the best predictors of pressure ulcer incidence in inpatient setting.

On **Chapter 6** we presented an unpublished article that aimed to **discuss our results** in a more direct and personal way (based on previous evidence studies and our clinical practice), highlighting our point of view in different domains and emphasising some aspects that should be taken into account by nurses when they design, plan and deliver care.

The study was performed with Hospital Council Board and Ethics Committee approval (Attach 3).

Each chapter/article had a specific methodological design that was described in “Material and Methods” section of each chapter.

Each chapter/article was structured according to each journal guidelines and all content was (re)printed with permission (Attach 4, Attach 5 and Attach 6).

During the development of this Thesis we participated in several scientific events and share our results through the publication of original articles, abstracts and oral and poster presentations (Appendix 1).

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CHAPTER 1

PRESSURE ULCER RISK ASSESSMENT

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Pressure ulcer risk assessment: retrospective analysis of Braden Scale scores in Portuguese hospitalised adult patients

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PRESSURE ULCER RISK ASSESSMENT:

RETROSPECTIVE ANALYSIS OF BRADEN SCALE SCORES

IN PORTUGUESE HOSPITALISED ADULT PATIENTS

ABSTRACT

Aims and objectives: To analyse the Braden Scale scores and sub-scores assessed in Portuguese hospitalized adult patients in association with their characteristics, diagnoses and length of stay.

Background: The Braden Scale is used worldwide for pressure ulcer risk assessment and supports nurses in the implementation of preventive interventions.

Design: Retrospective cohort analysis of electronic health record database from adult patients admitted to medical and surgical areas during 2012.

Methods: Braden Scale scores and sub-scores of 8147 patients were associated with age, gender, type of admission (emergency service or programmed), specialty units (medical or surgical), length of stay, patient discharge (discharge, decease or transference to other hospital), and ICD-9 diagnosis.

Results: The participants with significantly lower Braden Scale scores were women, older people, hospitalized in medical units, with emergency service admission, longer hospitalization stays and/or with vascular, traumatisms, respiratory, infection or cardiac diseases. Mobility, friction/shear forces and activity had higher contributions to the Braden Scale score, while nutrition had the lowest contribution.

Conclusions: Approximately one third of all participants had high risk of pressure ulcer development at admission, which led to the application of nursing preventive care. Our study demonstrated that nurses should pay special attention to patients over 50 years of age, who had significantly lower Braden Scale scores. The Braden Scale scores significantly increased in the last assessments showing that Braden Scale is sensitive to the clinical improvement of the patient. Braden Scale correlations with length of stay reveal its importance as predictor of length of stay.

Relevance to clinical practice: Nurses should use Braden Scale assessment and consider patients' characteristics and diagnoses to plan more focused preventive interventions and improve nursing care. This study could be the first step to create a preventive protocol based on institutional reality, patients' characteristics, level of risk and affected sub-scales.

KEYWORDS

Branden Scale; Clinical Judgement; Hospitalization; Nursing; Nursing Assessment; Pressure Ulcer; Risk Assessment.

WHAT DOES THIS PAPER CONTRIBUTE TO THE WIDER GLOBAL CLINICAL COMMUNITY?

National and international guidelines recommend that preventive protocols should exist, according to the institutional reality, and should be developed by the level of risk or affected sub-scale.

Women, older patients, with emergency service admission, hospitalized in medical units, with longer length of stay and with vascular, traumatisms/fractures or respiratory system diseases had lower Braden Scale scores.

Our findings suggest that nurses should use Braden Scale assessment and consider patients' characteristics and diagnoses to plan more focused preventive interventions and to improve nursing care.

This study could be the first step to create a preventive protocol based on the institutional reality, patients' characteristics, level of risk and affected sub-scales.

INTRODUCTION

Pressure ulcers continue to be a challenge to health care professionals and prevention strategies are discussed worldwide (NPUAP, EPUAP, & PPPIA, 2014; Stechmiller et al., 2008; Vanderwee et al., 2011). According to the European Pressure Ulcer Advisory Panel and National Pressure Ulcer Advisory Panel "A pressure ulcer is a localized injury to the skin and/or underlying tissue usually over a bony prominence, as a result of pressure, or pressure in combination with shear" (NPUAP et al., 2014). Pressure ulcers are a serious health problem especially among older care dependent people (Ferreira, Miguéns, Gouveia, & Furtado, 2007; Kottner, Halfens, & Dassen, 2009; Kwong, Pang, Aboo, & Law, 2009) and the first step in pressure ulcer prevention is the identification of individual risks (Ferreira et al., 2007; Kottner & Dassen, 2008; NPUAP et al., 2014). The purpose of pressure ulcer risk assessment is to identify those patients requiring preventive measures and their specific risk factors (Pancorbo-Hidalgo, Garcia-Fernandez, Lopez-Medina, & Alvarez-Nieto, 2006; Stechmiller et al., 2008).

BACKGROUND

A variety of pressure ulcer risk assessment scales has been developed (D. Anthony, Parboteeah, Saleh, & Papanikolaou, 2008; Papanikolaou, Lyne, & Anthony, 2007) since the creation of Norton scale in early 1960s (Norton, McLaren, & Exton-Smith, 1962). Although there is no evidence that the use of pressure ulcer risk assessment scales reduce the incidence of pressure ulcers by itself (D. Anthony et al., 2008; Chou et al., 2013; Pancorbo-Hidalgo et al., 2006) today, more than 30 risk assessment scales are known worldwide and are used in clinical practice (Defloor & Grypdonck, 2005; Kottner, Hauss, Schluer, & Dassen, 2013). Some authors (D. Anthony et al., 2008; Pancorbo-Hidalgo et al., 2006; Papanikolaou et al., 2007) critically review the most commonly used pressure ulcer risk instruments: the Norton scale; the Waterlow scale and the Braden Scale. In 2006, a systematic review of various studies published in Spanish, English, French and Portuguese, compared the three scales to determine which of them demonstrated the best reliability and validity (Pancorbo-Hidalgo et al., 2006). They concluded that the Braden Scale had been tested in the largest number of studies, and had demonstrated the best reliability and validity indicators in a variety of settings (Pancorbo-Hidalgo et al., 2006).

The Braden Scale (composed by six items: "sensory perception", "moisture", "activity", "mobility", "nutrition" and "friction/shear forces") has been found to have better predictive validity than nursing judgment on its own, which depends on nursing experience (Pancorbo-Hidalgo et al., 2006). However, the best care is prescribed when the Braden Scale is used in conjunction with proper nursing judgment (Braden, 2012). In fact, a good nursing judgment

would reveal risk factors not measured by the Braden Scale and the need for a higher intensity of preventive intervention (Braden, 2012). Consequently, when risk assessment is supplemented with good nursing judgment, proper nursing interventions and preventive measures, it is reasonable to expect that the incidence of full-thickness pressure ulcers will decrease (Braden, 2012; Comfort, 2008; Lynn et al., 2007). Nowadays there are several studies around the world using the Braden Scale in different care settings, like nursing homes (Defloor & Grypdonck, 2005; Lahmann, Halfens, & Dassen, 2005; Lahmann, Tannen, Dassen, & Kottner, 2011), intensive care units (ICU) (Cremasco, Wenzel, Zanei, & Whitaker, 2013; Tescher, Branda, Byrne, & Naessens, 2012) homecare settings (Kottner et al., 2009) and paediatric services (Kottner et al., 2013).

International guidelines (NPUAP et al., 2014) state that risk assessment should be done using a validated tool like Braden Scale at the admission and should be reassessed if there is any change in the patient's condition. The Portuguese guidelines (DGS, 2011) encourage the implementation of regular pressure ulcer risk assessments through the application of the Braden Scale. It also recommends the patients' categorization into two levels of risk, defined by cut-off point of 16, which determines the implementation of preventive interventions.

Following Portuguese guidelines (DGS, 2011), in 2012 "Centro Hospitalar Baixo Vouga, EPE – Unidade de Aveiro" (Aveiro Hospital) adopted the Braden Scale to identify patients at risk of developing pressure ulcers, and the evaluations are performed on all hospitalized patients at admission and repeated every 48 hours. Thus, patients with an evaluation of the Braden Scale score ≤ 16 have a high risk of developing pressure ulcers, and patients with a Braden Scale score evaluation > 16 have a lower risk of developing pressure ulcers. Although the pressure ulcer risk assessment is performed in a systematic way there is no formal protocol related to the implementation of preventive measures. Thus, nursing staff uses powered device in bed, non-powered device in bed and/or chair and repositioning every 2, 3 or 4 hours in a subjective way.

In order to create a preventive protocol based on our institutional reality, some research questions were raised: What are the characteristics of the patients classified as at risk of developing pressure ulcers according to Braden Scale score? Are there changes in Braden Scale scores during the length of stay? Is there any relation between the ICD-9 principal diagnosis and pressure ulcer risk assessed by the Braden Scale?

METHODS

Design

This study was designed as a retrospective cohort analysis of electronic health record database (medical and nursing) from adult patients admitted to medical and surgical areas of Aveiro Hospital from January 1, 2012 to December 31, 2012.

Aims

The main aim of this study was to analyse the Braden Scale scores and sub-scores assessed in Portuguese hospitalized adult patients in association with their characteristics, diagnoses and length of stay. Specific objectives were defined as follows: (1) To analyse the demographic and clinical characteristics of hospitalized adult patients classified as at risk of developing pressure ulcers, according to Braden Scale score. (2) To analyse the Braden Scale scores during the length of stay in hospitalized adult patients (3) To analyse the relation between ICD-9 principal diagnosis and Braden Scale scores in hospitalized adult patients.

Sample/Participants

The inclusion criteria were: (1) Patients with ≥ 18 years old at the time of admission; (2) Patients admitted and discharged in 2012; (3) Patients with emergency service or programmed hospital admission.

The exclusion criteria were: (1) Patients with less than 24 hours' length of stay; (2) Patients admitted to medical specialties of Psychiatry, Gynaecology, Obstetrics and Intensive Care.

Applying those criteria, we had a sample of 8147 adult patients admitted to medical and surgical areas in a Portuguese hospital during 2012.

Ethical considerations

The study was performed after Hospital Council Board and Ethics Committee approval. Confidentiality of the participants was maintained and no names or no identifying information was recorded.

Data collection

The first ten and the last assessments of Braden Scale scores were extracted from electronic health record database. The six Braden sub-scales scores were obtained from the first and the last assessments. Other demographic and clinical data were extracted from the same

electronic health record database, and included the following variables: age, gender, type of admission (emergency service or programmed), specialty unit (medical or surgical), length of stay, patient discharge (discharge, decease or transference to other hospital), and principal diagnosis by the ICD-9. The variable length of stay was arbitrarily dichotomized according to a cut-off of 20 days of hospitalization and the variable age was divided in seven groups, namely 18-29, 30-39, 40-49, 50-59, 60-69, 70-79 and ≥ 80. Though, a cut-off point of 65 year-old was used for the analysis of Braden Scale scores during the first 20 days of hospitalization.

Data analysis

Data were analysed using the Statistical Package for the Social Sciences software, version 21.0. Descriptive statistics were calculated for the demographic and clinical variables and sample characterization. Normal distribution was assessed with Kolmogorov-Smirnov test. Non-parametric tests (Mann-Whitney and Kruskal-Wallis) were used for comparison of means. Odds ratio (OR) were calculated by logistic regression. Estimates for the contributions of age and admission to the Braden Scale score were calculated by multivariate linear regression, stepwise method with probabilities of entry and removal of, respectively, 0.5 and 0.1. Correlations were determined using Spearman coefficient and item-partial total correlation, being classified as very strong (0.8-1.0), strong (0.6-0.79), moderate (0.40-0.59), weak (0.2-0.39) and very weak (0.0-0.19) (Swinscow, 1997). Wilcoxon test was used to compare the first and the last assessment of Braden scale score and Braden sub-scales scores. In all analyses, a p-value < 0.05 indicated statistical significance.

Validity and reliability/Rigour

The Braden Scale score ranges from 6 to 23 and is composed of 6 factor sub-scales: “sensory perception”, “moisture”, “activity”, “mobility”, “nutrition” and “friction/shear forces”. Each sub-scale is rated 1 to 4, except for “friction/shear forces”, which is rated 1 to 3 (the smallest value corresponds to a higher risk of developing pressure ulcers). The total score is used to predict overall risk of pressure ulcer development (N. Bergstrom, Braden, Kemp, Champagne, & Ruby, 1998; N Bergstrom & Braden, 2002; N Bergstrom, Braden, Laguzza, & Holman, 1987).

The Portuguese version of Braden Scale was validated in 2001 and there is a National guideline that encourages the implementation of regular pressure ulcer risk assessments through the application of that instrument. It also recommends the patients’ categorization into two levels of risk, defined by cut-off point of 16, which determines the implementation of preventive interventions (DGS, 2011).

RESULTS

This study included a sample of 8147 participants, 4206 were male (52%) and 3941 were female (48%), 4980 were older than 64 (61%), being the mean age 66.4 ± 18.1 years (mean ± SD) (Table 1.C1). According to the admission, 74% of the participants came from emergency service, while the other 26% had a programmed admission. They were admitted in surgical units (56%) or in medical units (44%). The median length of stay of the population in study was 7 days (Q25 = 3 days and Q75 = 11 days), with 8% of the participants hospitalized more than 20 days. 72% of the study population were discharged, 22% were transferred to another hospital and 6% died during the hospitalization. The study population were grouped by the principal discharge diagnosis, according to the ICD-9 classification, as the following diseases: digestive (20%); respiratory (15%); musculoskeletal (9%), vascular (9%), cardiac (9%), genitourinary (9%), traumatisms/fractures (7%), neoplasms (7%), infectious (3%), endocrine/metabolic (2%), skin (2%), central nervous (2%), hematologic (1%) and the other diseases (5%).

Braden Scale score results – First assessment

The mean Braden Scale score in the first assessment was 17.8 ± 3.4 (mean ± SD). According to table 2.C1, statistically significant differences were observed due to gender, admission, specialty, dichotomized length of stay ($p < 0.001$, Mann-Whitney test), group age and diagnosis ($p < 0.001$, Kruskal-Wallis test). In the first assessment 31% of the men and 38% of the women are at risk of developing pressure ulcers, and women had an OR 1.39 (95% CI, 1.27-1.53) higher than men. Also, the odds ratio for being classified in the risk group for developing pressure ulcer increased with age, and is significantly higher in the categories over 50 years old in comparison with the category of 18-29 year-old ($p < 0.001$). The OR is 2.07 among the participants with ages comprised between 50-59, and respectively, 2.73, 6.05 and 16.39 among the participants aged 60-69, 70-79 and 80 or more, when compared with the ones aged 18-29. The type of admission and specialty unit are associated with risk group classification (medical units: OR 2.71; 95% CI, 2.46-2.97 / participants admitted from emergency service: OR 8.15; 95% CI, 6.96-9.55). As well, being hospitalized for 20 days or more is associated with the patient's higher odds of being classified in the risk group for developing pressure ulcers (OR 2.38; 95% CI, 2.03-2.80). Participants with vascular diseases, traumatisms/fractures and respiratory system diseases had lower Braden Scale scores in the first assessment, therefore were classified in the group with higher risk for developing pressure ulcers (Figure 1.C1).

Estimates of the contribution of age and admission to Braden Scale score were done for each group of diagnosis using multivariate linear regression. Depending on the diagnosis,

the age and admission could explain about 15 to 50% of the variability, as presented on table 3.C1. Additionally, Braden Scale score and length of stay were significantly (p < 0.001) correlated for all underlying diagnosis with exception for hematologic diseases. Moderate correlations between Braden Scale scores and length of stay were found in genitourinary (rho = -0.524), endocrine/metabolic (rho = -0.492), skin (rho = -0.460), central nervous (rho = -0.434), and vascular (rho = -0.413) diseases.

The Spearman correlations between Braden sub-scales and Braden Scale revealed very strong correlations for “activity” (rho = 0.858), “mobility” (rho = 0.832) and “friction/shear forces” (rho = 0.813); strong correlations for “sensory perception” (rho = 0.676); moderate correlations for “moisture” (rho = 0.594); and weak correlations for “nutrition” (rho = 0.345).

If “nutrition” were left out of the scale sum score, the item-partial correlations would improve for most of the items. Very strong correlations were established with “mobility” (0.868), “friction/shear forces” (0.858) and “activity” (0.847) and strong correlations were established with “sensory perception” (0.722) and “moisture” (0.649).

Braden Scale score results – Last assessment

The mean Braden Scale score in the last assessment was 18.6 ± 3.4 (mean± SD). According to table 2.C1, statistically significant differences were observed due to gender, admission, specialty, dichotomized length of stay (p < 0.001, Mann-Whitney test), group age, diagnosis and patient discharge (p < 0.001, Kruskal-Wallis test). The OR in the last assessment of Braden Scale scores were similar to those found in the first assessment according to gender, age, specialty, admission, and length of stay (table 2.C1). We found that 14% (n = 841) of the participants who went home after hospitalization were at risk of developing pressure ulcer according to the last assessment. 6% of the study population (n=490) died during the hospitalization. Among these 82% and 93% were at risk of developing pressure ulcer, respectively, in the first and last assessments. These participants experienced a significant decrease in the Braden Scale score during the hospitalization from 13.9 ± 2.90 to 12.6 ± 2.63 (p < 0.001, Wilcoxon test), while the others experienced a significant increase in the Braden Scale score during the hospitalization (p < 0.001, Wilcoxon test).

On the overall population, the last assessment of Braden Scale score had a statistically significant improvement compared with the first assessment (p < 0.001, Wilcoxon test). However, not all the Braden sub-scales showed statistically significant differences, namely “moisture” and “sensory perception”. Variations in some sub-scales of participants hospitalized less than 20 days were different from the overall population. Significant improvements of the total score and sub-scales scores “friction/shear forces”, “activity”,

"mobility", and "nutrition" ($p < 0.001$, Wilcoxon test) were observed among the overall population (and the population hospitalized less than 20 days). But considering the participants hospitalized for 20 or more days, the "friction/shear forces" (p = 0.653), "moisture" (p = 0.535) and "mobility" (p = 0.485) did not show any improvement and "sensory perception" was significantly worse ($p = 0.031$) (figure 2.C1).

Braden Scale score results – Length of stay

During the hospitalization, the patients were assessed for Braden Scale every two days. We analysed the first 10 assessments of Braden Scale score for the participants that remained hospitalized 20 days or more. The participants aged 65 or more had significantly lower Braden Scale scores than the ones younger than 65. Furthermore, these (participants younger than 65) had the result of the 10^{th} assessment of Braden scale significantly higher than the first one ($p < 0.01$, Wilcoxon test) (Figure 3A.C1). We also analysed these differences according to the diagnosis and found significant differences related to age only in participants with infectious diseases (ICD-9) (Figure 3B.C1).

DISCUSSION

This study investigated the patients hospitalized in Aveiro Hospital and analysed the population at risk of developing pressure ulcers according to clinical and patient characteristics.

Considering the cut-off point of 16, established by Portuguese guidelines (DGS, 2011), the participants classified as at risk of developing pressure ulcers comprises more than one third of the study population (34.4%).

Using similar inclusion criteria and the same cut-off value, Vanderwee, Clark, Dealey, Gunningberg, and Defloor (2007) developed a survey in 25 hospital sites across five European countries and found that 35.5% of the participants were classified as at risk of developing pressure ulcers (22.5% in Italy, 30.8% in Portugal, 35.0% in Sweden, 41.2% United Kingdom and 42.1% in Belgium).

A multicentre study developed by Ferreira et al. (2007) in 8 Portuguese hospitals, using the same cut-off value, found that 37.4% of the participants were classified as at risk of developing pressure ulcers. However, their sample (n=9810) included 567 participants in Critical Care Services (193 participants in Intensive Care Units and 374 participants in Emergency Room). Those patients are the ones with lower Braden Scale scores, increasing the percentage of patients classified as at risk of developing pressure ulcers in that survey.

If we considered the cut-off point of 18, used in other international studies (Lahmann et al., 2005; Tubaishat, Anthony, & Saleh, 2011; Uzun & Tan, 2007), more than a half of our participants (53.3%) would be classified as at risk of developing pressure ulcers. Our results were higher than the ones reported by Uzun and Tan (2007) in a Turkish hospital (32.3%), Tubaishat et al. (2011) in two Jordanian hospitals (28%) and Lahmann et al. (2005) in German hospitals (26.1%). So, the lower Braden Scale scores found in our population suggest that our participants could present a worse clinical condition that required higher levels of nursing care.

Our study found differences in the Braden score due to age, gender, admission, specialty, length of stay and diagnosis. Participants who had lower Braden Scale scores were women, older than 50, with emergency service admission, hospitalized in medical units and/or with longer hospitalization stays.

Related to gender, our results differ from the ones of Uzun and Tan (2007), as we found that women had lower Braden Scale scores. However, these results matched the cited study of Uzun and Tan (2007) for the variables age, specialty units and length of stay.

Also, age (Cox, 2011) and length of intensive care unit stay (Cox, 2011; Cremasco et al., 2013) were identified as significant risk factors for pressure ulcer development. Moreover, Cox (2011) recognized that age should be given stronger consideration for inclusion in a risk assessment scale.

Although a Brazilian study stated no statistical differences in the Braden Scale score according to the diagnosis and co-morbidity (Menegon et al., 2012), our results demonstrated significant differences according to the diagnosis (ICD-9). The participants with vascular, traumatisms, respiratory, infection or cardiac diseases had significant lower Braden Scale scores compared to other diagnoses. In fact, cardiovascular disease (Amir, Meijers, & Halfens, 2011; Cox, 2011), infection (Amir et al., 2011; Cox, 2011), acute respiratory failure (Tescher et al., 2012) and respiratory disease (Amir et al., 2011) had already been documented to be associated with patients' risk of pressure ulcer development.

Cremasco et al. (2013) showed that illness severity was a significant risk factor for pressure ulcers development. Indeed, our results showed that 93% of the participants who died in the hospital were classified as at risk of developing pressure ulcers in the last assessment and only 14% of discharge patients were classified as at risk of developing pressure ulcers in the last assessment. These results suggest that there is an association between illness severity and Braden Scale scores, meaning that the worsening of the patient condition (sometimes leading to death) is reflected in the decreasing of the Braden Scale scores during the length

of stay. On the other hand, our data suggests that when the patient condition improves we notice an improvement of their physical activity and ability to change and control body position, reducing the friction and shear forces. In fact, as far as Braden sub-scales items are concerned, our study showed that “activity”, “mobility” and “friction/shear forces” had a higher correlation with the Braden Scale score.

According to Sharp and McLaws (2006), the greatest effort in assessing pressure ulcer risk needs to focus on mobility. The sub-scale “mobility” was significantly predictive of pressure ulcer in Cox (2011) study. The “friction/shear forces” were also predictive but only for pressure ulcer category II, III or IV (Cox, 2011). Moreover, some correlation studies identified the sub-scale “friction/shear forces” as the most important predictor for the pressure ulcer prevalence (Lahmann et al., 2011; Tescher et al., 2012), but there are inconclusive evidences with this sub-scale (Cox, 2011). Interestingly, limited activity was found to be a predictor of pressure ulcer in hospitals (Amir et al., 2011), but not in intensive care units (Cox, 2011).

Cox (2011) and Tescher et al. (2012) reported that the sub-scale “nutrition” was not a significant predictor of pressure ulcer development and in our study we have found that the sub-scale “nutrition” had the lowest correlation with the Braden Scale score. However, nutrition or poor nutrition is a factor that predisposes the pressure ulcer development (Sharp & McLaws, 2006). In fact, the patients with lower albumin levels (Denis Anthony, Reynolds, & Russell, 2000; Serra et al., 2013; Uzun & Tan, 2007) and lower body mass index (Serra et al., 2013; Uzun & Tan, 2007) have increased risk for pressure ulcer development. Thus, the low correlations between “nutrition” sub-scale and Braden Scale or pressure ulcer development may indicate that nutrition has not been accessed objectively, has low sensitivity as biological measure of nutrition and gives no guarantee of inter-rater reliability between health care workers (Sharp & McLaws, 2006). To circumvent this problem, we need to better understand nutrition and nutrition assessment. At least we suggest the adoption of NPUAP et al. (2014) recommendations, stating that at a minimum, assessment of nutritional status should include regular weight checks and documentation of food and fluid intakes.

On the overall population the Braden Scale scores were significantly higher in the last assessments related to the first ones, indicating the patient’s overall recovery. However, taking in account the participants who died during the hospitalization, we found a decrease in the Braden Scale scores. Also the significant correlations found between the length of stay and Braden Scale scores, demonstrate that Braden Scale can be used as predictor of the length of the hospitalization, especially in the participants with genitourinary, endocrine/metabolic, skin, central nervous and vascular diseases. So, if the pressure ulcer

risk assessment is done accordingly and takes in consideration patient´s characteristics, it may allow us to predict the length of hospitalization.

Our results made us aware of some demographic and clinical characteristics of the patients that are more susceptible to the risk of developing pressure ulcers and what sub-scales most contribute to Braden Scale score.

Limitations

This study was designed as a retrospective cohort analysis of electronic health record database and the limitations are due to data recording and database characteristics. We realized that there are important variables that could help us to improve our findings but we identify several problems with database architecture that prevent us to collect and analyse data related to pressure ulcer prevalence, pressure ulcer incidence and nursing preventive interventions for the study population.

CONCLUSION

Approximately one third of all participants had high risk of pressure ulcer development at the first assessment at Aveiro Hospital. Our study associated Braden Scale scores with patients' characteristics and diseases, which may help to identify the patients with more nursing care needs across hospitalization. Lower Braden Scale scores were found in women, older people, patients with emergency service admission, with longer hospitalization stays, hospitalized in medical units and/or with vascular, traumatisms, respiratory, infection or cardiac diseases. Besides confirming the increased odds for developing pressure ulcers with age, our study demonstrated that these odds were significantly higher for the categories over 50 years old.

Concerning the 6 Braden sub-scales, our study corroborate that "activity", "mobility" and "friction/shear forces" had a higher contribution to the Braden Scale score, but the low contribution of sub-scale "nutrition" may suggest the need to optimize nutrition assessment.

For overall population the Braden Scale scores significantly increased in the last assessment. However, for over 90% of the participants who died in our hospital we found a decrease in the Braden Scale score. This demonstrates that Braden Scale detects the patient's clinical improvement or worsening, having the sensitivity for changes in the patient condition. Moreover, we were able to demonstrate the importance of Braden Scale as a predictor of the length of the hospitalization, especially in the participants with genitourinary, endocrine / metabolic, skin, central nervous and vascular diseases.

RELEVANCE TO CLINICAL PRACTICE

We are aware that there is no evidence that the use of pressure ulcer risk assessment scales reduce the incidence of pressure ulcers by itself. Nevertheless, we considered that preventive protocols should exist based on risk assessment and institutional reality.

While the pressure ulcer risk assessment is performed in a systematic way there is no formal protocol in our hospital related to the implementation of preventive measures and nursing staff uses powered device in bed, non-powered device in bed and/or chair and repositioning every 2, 3 or 4 hours in a subjective way, based on individual judgment and individual experience. We believe in nursing staff knowledge and expertise to provide the best care for our patients in different care settings, but we miss a formal protocol based on international guidelines and institutional reality. So, we highlight the need to standardize procedures and nursing data record. This will allow us to compare data between different services / institutions and identify advanced education / training needs.

Our findings suggest that nurses should use Braden Scale assessment and consider patients' characteristics and diagnoses to plan more focused preventive interventions and to improve nursing care. Thus, this study could be the first step to create a preventive protocol based on the institutional reality, patients' characteristics, level of risk and affected sub-scales.

Furthermore, our study suggests that Braden Scale detects the patient's clinical improvement or worsening. Therefore, nurses should be aware that Braden Scale score, besides assessing the pressure ulcer risk, might contribute to detect changes in the patient condition.

The degree of physical activity, the ability to change and control body position and friction and shear forces were the items assessed by Braden Scale that most contribute to the Braden Scale score. Consequently, these items should have an important role in nursing care plan to improve the patients' physical capacity / independence.

The low correlations between "nutrition" sub-scale score and Braden Scale score may indicate that nutrition (or poor nutrition) has not been accessed objectively in our hospital. So, we suggest the adoption of a nutritional assessment tool that besides documentation of food and fluid intakes should include anthropometrics evaluations and (ideally) biochemical data.

Additionally, this study allowed us to find some limitations in hospital database and we are already working with Hospital Administration, Informatics and Systems Analysis Service and Nursing staff to upgrade nursing assessment documentation, nursing interventions

documentation and hospital database in order to improve pressure ulcer prevention, assessment and treatment.

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Table 1.C1 – Characterization of the overall population in study (n = 8147) and characterization of the male and female populations.

	Male (n = 4206)	**Female** (n = 3941)	**Total** (n = 8147)
Age			
mean ± SD	64.8 ± 17.9	68.3 ± 18.0	66.4 ± 18.1
≥ 65	2433 (57.8%)	2547 (64.6%)	4980 (61.1%)
Admission			
Emergency service	3139 (74.6%)	2851 (72.3%)	5990 (73.5%)
Programmed	1067 (25.4%)	1090 (27.7%)	2157 (26.5%)
Patient discharge			
Discharge	3068 (72.9%)	2804 (71.1%)	5872 (72.1%)
Decease	258 (6.1%)	232 (5.9%)	490 (6.0%)
Transference	880 (20.9%)	905 (23.0%)	1785 (21.9%)
Length of stay			
mean ± SD	8.9 ± 9.6	8.6 ± 8.5	8.8 ± 9.1
≥ 20 days	355 (8.4%)	307 (7.8%)	662 (8.1 %)
Specialty			
Medicine	1866 (44.4%)	1690 (42.9%)	3556 (43.6%)
Surgery	2340 (55.6%)	2251 (57.1%)	4591 (56.4%)
Diagnosis			
Infectious	150 (3.6%)	116 (2.9%)	266 (3.3%)
Neoplasms	319 (7.6%)	213 (5.4%)	532 (6.5%)
Endocrine/Metabolic	70 (1.7%)	101 (2.6%)	171 (2.1%)
Hematologic	31 (0.7%)	53 (1.3%)	84 (1.0%)
Central nervous	63 (1.5%)	88 (2.2%)	152 (1.9%)
Cardiac	396 (9.4%)	332 (8.4%)	728 (8.9%)
Vascular	347 (8.3%)	384 (9.7%)	731 (9.0%)
Respiratory	665 (15.8%)	573 (14.5%)	1238 (15.2%)
Digestive	867 (20.6%)	754 (19.1%)	1621 (19.9%)
Genitourinary	407 (9.7%)	316 (8.0%)	723 (8.9%)
Skin	80 (1.9%)	51 (1.3%)	131 (1.6%)
Musculoskeletal	306 (7.3%)	458 (11.6%)	764 (9.4%)
Traumatic/Facture	268 (6.4%)	330 (8.4%)	598 (7.3%)
Others	237 (5.6%)	171 (4.3%)	408 (5.0%)
Braden Scale – First assessment			
Total (mean ± SD)	18.1 ± 3.4	17.5 ± 3.5	17.8 ± 3.4
Braden Scale – Last assessment			
Total (mean ± SD)	18.9 ± 3.4***	18.3 ± 3.4***	18.6 ± 3.4***

***$p < 0.001$, Wilcoxon and Sign tests: Braden Scale score first assessment vs last assessment

Table 2.C1 – Descriptive statistics of participants classified as "at risk" in the first and last assessments of Braden Scale (Braden Scale score ≤ 16, n = 2800) and the odds ratio for having a Braden Scale score ≤ 16. The differences between groups (*p* values) were calculated with the Mann-Whitney test for the variables gender, admission, dichotomized length of stay and specialty, and Kruskall-Wallis test for the variables group age, patient discharge and diagnosis.

	First Assessment		Last Assessment	
	BS ≤ 16 2800 (34.4%)	**OR (95% CI)**	**BS ≤ 16** 2112 (25.9%)	**OR (95% CI)**
Gender (*p* = 0.000)				
Male	1294 (46.2%)	1	970 (45.9%)	1
Female	1506 (53.8%)	1.39 (1.27-1.53)	1142 (54.1%)	1.36 (1.23-1.50)
Age (*p* = 0.000)				
18-29	34 (1.2%)	1	18 (0.9%)	1
30-39	53 (1.9%)	1.25 (0.79-1.96)	35 (1.7%)	1.56 (0.87-2.80)
40-49	89 (3.2%)	1.49 (0.98-2.26)	52 (2.5%)	1.62 (0.93-2.82)
50-59	172 (6.1%)	2.07 (1.41-3.06)	88 (4.2%)	1.91 (1.31-3.21)
60-69	296 (10.6%)	2.73 (1.88-3.98)	171 (8.1%)	2.80 (1.70-4.61)
70-79	769 (27.5%)	6.05 (4.20-8.70)	554 (26.2%)	7.36 (4.54-11.94)
≥ 80	1387 (49.5%)	16.39 (11.40-23.56)	1194 (56.5%)	22.69 (14.03-36.70)
Admission (*p* = 0.000)				
Programmed	187 (6.7%)	1	n/a	n/a
Emergency service	2613 (93.3%)	8.15 (6.96-9.55)	n/a	n/a
Patient discharge (*p* = 0.000)				
Discharge	n/a	n/a	841 (39.8%)	1
Decease	n/a	n/a	457 (21.6%)	82.84(57.76-118.83)
Transference	n/a	n/a	814 (38.5%)	5.02 (4.46-5.65)
Length of stay (*p* = 0.000)				
< 20	2445 (87.3%)	1	1810 (85.7%)	1
≥ 20	355 (12.7%)	2.38 (2.03-2.80)	302 (14.3%)	2.63 (2.24-3.09)
Specialty (*p* = 0.000)				
Surgery	1131 (40.4%)	1	766 (36.3%)	1
Medicine	1669 (59.6%)	2.71 (2.46-2.97)	1346 (63.7%)	3.04 (2.74-3.37)

BS, Braden Scale; n/a, not applicable

Table 3.C1 – Multivariate regression model, stepwise method, for prediction of Braden Scale scores using the variables age and admission. Spearman correlation of Braden Scale scores and length of stay.

	Variability (%)	Age		Admission		Constant		ANOVA	Correlation BS vs. length of stay - Rho
		B	(95% CI)	B	(95% CI)	B	(95% CI)		
All Subjects	34.6	-0.073	(-0.076; -0.069)	2.885	(2.744; 3.026)	21.889	(21.641; 22.137)	<0.001	-0.370
Diagnosis									
Infectious	46.6	-0.122	(-0.140; -0.105)	2.169	(0.925; 3.412)	24.769	(23.602; 25.935)	0.001	-0.316
Neoplasms	33.9	-0.052	(-0.067; -0.036)	3.001	(2.569; 3.433)	21.419	(20.314; 22.523)	<0.001	-0.250
Endocrine/Metabolic	46.7	-0.072	(-0.098; -0.047)	3.210	(2.286; 4.135)	20.639	(19.272; 23.550)	<0.001	-0.492
Hematologic	35.7	-0.079	(-0.103; -0.054)	1.819	(0.133; 3.504)	23.548	(21.896; 25.201)	<0.05	ns.
Central nervous	39.7	-0.055	(-0.080; -0.031)	3.679	(2.842; 4.516)	20.064	(18.521; 21.607)	<0.001	-0.434
Cardiac	15.4	-0.058	(-0.070; -0.045)	2.768	(2.023; 3.513)	21.558	(20.615; 22.501)	<0.001	-0.317
Vascular	41.4	-0.088	(-0.102; -0.073)	4.198	(3.528; 4.868)	21.819	(20.712; 22.926)	<0.001	-0.413
Respiratory	43.4	-0.105	(-0.116; -0.094)	2.602	(1.966; 3.237)	23.821	(23.009; 24.634)	<0.001	-0.347
Digestive	28.7	-0.046	(-0.052; -0.039)	2.985	(2.701; 3.268)	20.702	(20.262; 21.143)	<0.001	-0.282
Genitourinary	48.9	-0.093	(-0.105; -0.082)	3.472	(3.031; 3.914)	23.561	(22.705; 24.416)	<0.001	-0.524
Skin	34.8	-0.086	(-0.107; -0.066)	ns	ns	23.584	(22.311; 24.857)	<0.001	-0.460
Musculoskeletal	15.8	-0.055	(-0.067; -0.042)	1.969	(1.497; 2.442)	20.370	(19.465; 21.275)	<0.001	-0.362
Traumatic/Facture	16.5	-0.054	(-0.064; -0.044)	ns	ns	20.026	(19.357; 20.695)	<0.001	-0.386
Others	23.3	-0.061	(-0.077; -0.045)	2.595	(1.866; 3.323)	21.851	(20.770; 22.932)	<0.001	-0.237

B, unstandardized regression coefficient; BS, Braden Scale; CI, confidence interval and ns, not significant.

Figure 1.C1

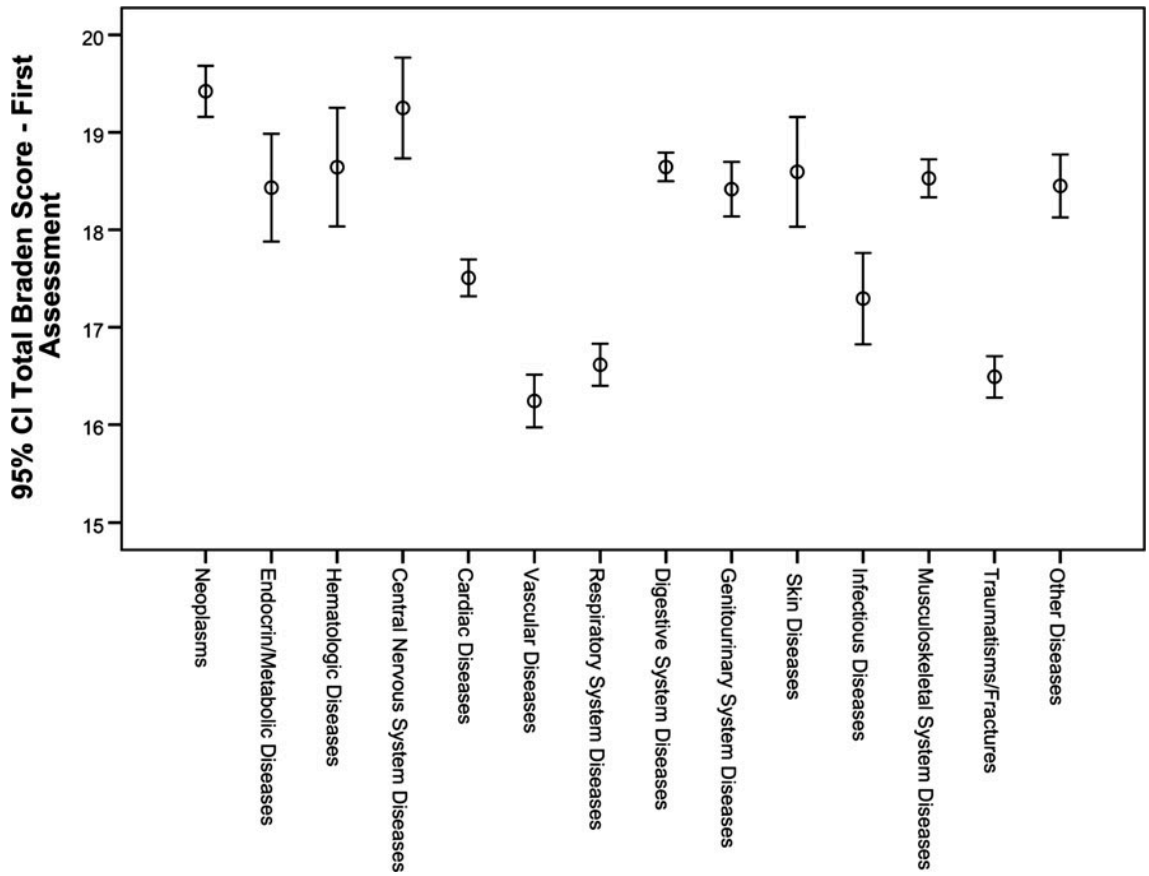

Figure 1.C1 – Mean Braden Scale score and confidence intervals (95% CI) in the first assessment according to the principal diagnosis.

Figure 2.C1

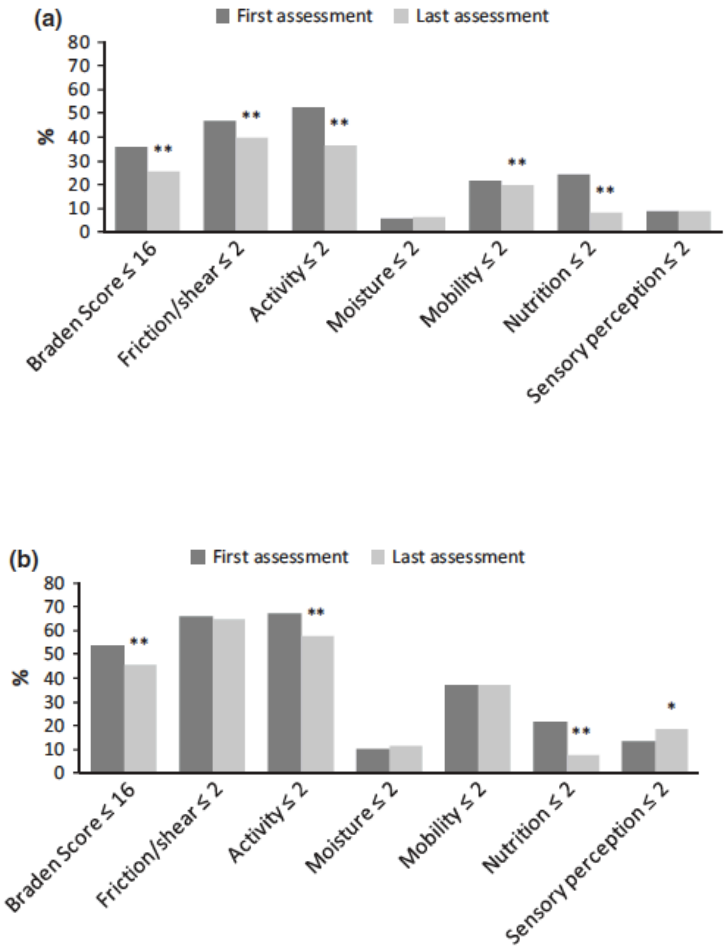

Figure 2.C1 – Comparison between the first and the last assessment of Braden Scale. The percentage of participants with lower scores (Braden Scale score ≤ 16 and sub-scores ≤ 2) is represented in the first and last assessment. (A) Represents the participants with less than 20 days of hospitalization. (B) Represents the participants hospitalized for 20 days or more. Statistical differences between the first and the last assessment were determined by the Wilcoxon test and were considered significant for $p < 0.05$ (*); (** $p = 0.000$).

Figure 3.C1

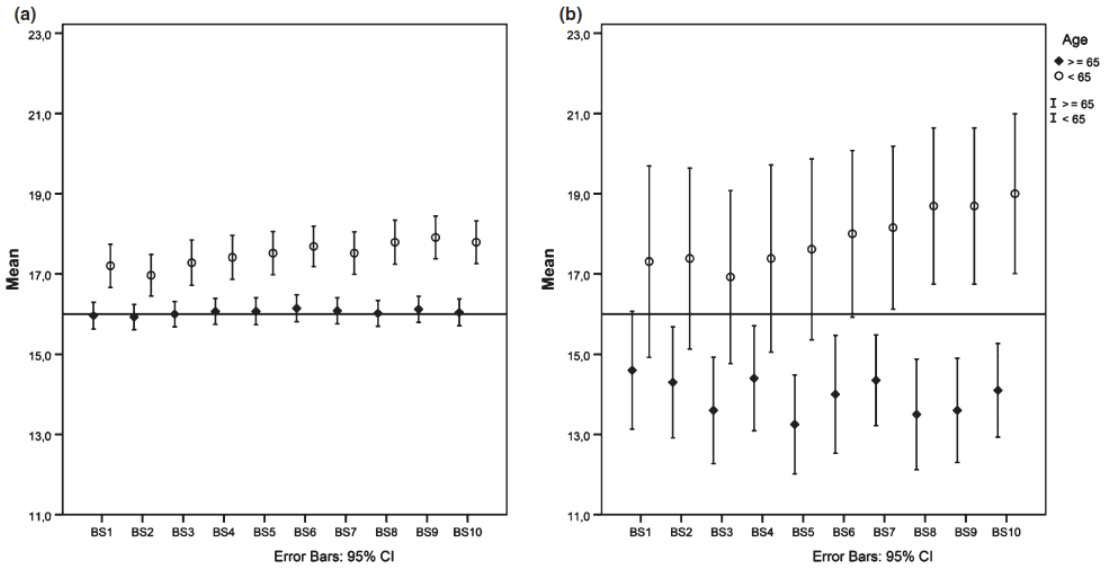

Figure 3.C1 – Mean Braden Scale score and confidence intervals (95% CI) for the first 10 assessments of Braden Scale score, in the participants hospitalized for 20 days or more. (A) Represents all the participants hospitalized for 20 days or more, subdivide by 65 age cut-off. (B) Represents the participants hospitalized for 20 days or more and diagnosed with infectious disease, subdivided by 65 age cut-off.

CHAPTER 2

PRESSURE ULCER (POINT) PREVALENCE

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Pedro Sardo, Cláudia Simões, José Alvarelhão, César Costa, Carlos Simões, Jorge Figueira, João Simões, Francisco Amado, António Amaro and Elsa Melo

Analyses of pressure ulcer point prevalence at the first skin assessment in a Portuguese hospital

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ANALYSES OF PRESSURE ULCER POINT PREVALENCE

AT THE FIRST SKIN ASSESSMENT IN A PORTUGUESE HOSPITAL

ABSTRACT

Aim: To analyse the first pressure ulcer risk and skin assessment records of hospitalized adult patients in medical and surgical areas of Aveiro Hospital during 2012 in association with their demographic and clinical characteristics.

Material and Methods: Retrospective cohort analysis of electronic health record database from 7132 adult patients admitted to medical and surgical areas in a Portuguese hospital during 2012. The presence of (at least) one pressure ulcer at the first skin assessment in inpatient setting was associated with age, gender, type of admission, specialty units, length of stay, patient discharge and ICD-9 diagnosis.

Results: Point prevalence of participants with pressure ulcer category/stage I-IV of 7.9% at the first skin assessment in inpatient setting. A total of 1455 pressure ulcers were documented, most of them category/stage I. The heels and the sacrum/coccyx were the most problematic areas. Participants with pressure ulcer commonly had two or more pressure ulcers.

Conclusions: The point prevalence of participants with pressure ulcer of our study was similar international literature. The presence of a pressure ulcer at the first skin assessment could be an important measure of frailty and the participants with pressure ulcer commonly had more than one documented pressure ulcer. Advanced age or lower Braden Scale scores or Emergency Service admission were relevant variables for the presence of (at least) one pressure ulcer at the first skin assessment in inpatient setting as well as respiratory, infectious or genitourinary system diseases.

KEYWORDS

International Classification of Diseases; Nursing; Nursing Assessment; Pressure Ulcer; Prevalence; Risk Assessment.

HIGHLIGHTS

Point prevalence of participants with pressure ulcers of 7.9%.

Most of the pressure ulcers recorded were category/stage I.

The most problematic areas were the heels and the sacrum/coccyx.

60.4% of the participants with pressure ulcer had two or more pressure ulcers.

INTRODUCTION

Pressure ulcers continue to be a challenge to healthcare professionals (Dealey et al., 2013; NPUAP, EPUAP, & PPPIA, 2014; Sardo et al., 2015) and represent an indicator of healthcare quality (Dealey et al., 2012; Hopkins, 2012; Silva et al., 2013). In fact, effective pressure ulcer prevention depends on health care professionals (especially nurses) that identify patients who are particularly vulnerable to pressure damage due to their specific risk factors (Dealey et al., 2013; NPUAP et al., 2014; Sardo et al., 2015). Nowadays more than 30 pressure ulcer risk assessment scales are known worldwide and are used in clinical practice (Defloor & Grypdonck, 2004, 2005; Kottner, Hauss, Schluer, & Dassen, 2013). However, preventive measures are not always effectively implemented (Gallagher et al., 2008; Vanderwee, Clark, Dealey, Gunningberg, & Defloor, 2007) and the prevalence of pressure ulcers in hospitals is still high (Vanderwee, Grypdonck, & Defloor, 2007).
In order to follow national guidelines (DGS, 2011), Registered Nurses and/or Clinical Nurses Specialist should perform a pressure ulcer risk assessment using the Braden Scale (Attach 1) as well as a skin integrity assessment using the Skin Assessment Tool (Attach 2) every 24 hours in emergency rooms and intensive care units. In inpatient settings that assessment should be performed at admission and repeated every 48 hours during the length of stay. At "Centro Hospitalar do Baixo Vouga, EPE – Unidade de Aveiro" (Aveiro hospital) these systematic assessments have been carried out (only) in inpatient settings since 2012.
The purpose of this study was to analyse the first pressure ulcer risk and skin assessment records of hospitalized adult patients in medical and surgical areas of Aveiro Hospital during 2012 in association with their demographic and clinical characteristics.

Specific objectives were defined as follows: [1] To calculate the prevalence of pressure ulcers in hospitalized adult patients at the first skin assessment in inpatient setting; [2] To identify the category/stage of pressure ulcers in hospitalized adult patients at the first skin assessment in inpatient setting; [3] To identify the location of pressure ulcers in hospitalized adult patients at the first skin assessment in inpatient setting; and [4] To analyse the demographic and clinical characteristics of hospitalized adult patients who had (at least one) pressure ulcer at the first skin assessment in inpatient setting.

MATERIAL AND METHODS

Design

This study was designed as a retrospective cohort analysis of electronic health record database from adult patients admitted to medical and surgical areas of the Aveiro Hospital from January 1, 2012 to December 31, 2012.

Sample / Participants

The inclusion criteria were: [1] Patients with ≥ 18 years old at the time of admission; [2] Patients admitted and discharged in 2012; [3] Patients with emergency service or programmed hospital admission. The exclusion criteria were: [1] Patients with less than 24 hours' length of stay; [2] Patients admitted to specialties of Psychiatry, Gynaecology, Obstetrics and Intensive Care; [3] Patients without pressure ulcer risk assessment and/or skin assessment at the admission in inpatient setting.

Ethical issues and approval

The study was performed after Hospital Council Board and Ethics Committee approval. Confidentiality of the participants was maintained and no names or identifying information was recorded.

Data collection

All data were extracted from electronic health record database with the collaboration of Hospital Informatics and Systems Analysis Service and included the following variables: first pressure ulcer risk assessment (Braden Scale score), first skin assessment (Skin Assessment Tool record), age, gender, type of admission (emergency service or programmed), specialty unit (medical or surgical), patient discharge outcome (discharge, decease or transference to another hospital/health institution) and diagnosis.

The Braden Scale score ranges from 6 to 23 and is composed by six factor sub-scales: "sensory perception", "moisture", "activity", "mobility", "nutrition" and "friction/shear forces". Each sub-scale is rated 1 to 4, except for "friction/shear forces", which is rated 1 to 3 (the smallest value corresponds to a higher risk of developing pressure ulcers). The total score is used to predict overall risk of pressure ulcer development (Nancy Bergstrom, 2002; N. Bergstrom, Braden, Kemp, Champagne, & Ruby, 1998; N. Bergstrom, Braden, Laguzza, & Holman, 1987). Following national guidelines (DGS, 2011) participants with Braden Scale score ≤ 16 were classified as "at risk of developing pressure ulcers", and participants with a Braden Scale score > 16 were classified as "not at risk of developing pressure ulcers".

The Skin Assessment Tool is composed by a body chart that identifies 29 different areas to assess the skin integrity and/or the presence of pressure ulcers, their location, size, depth and category/stage (DGS, 2011). The anatomical location was recorded according to national guidelines (DGS, 2011) which identify 29 areas of developing pressure ulcers. Those locations were converted to the regions recommended by EPUAP and NPUAP, prior to the data analysis. Thus, the final location was organized into the following anatomical

regions: Occiput; Ear; Scapula; Spinous Process; Shoulder; Elbow; Iliac Crest; Sacrum/Coccyx; Ischial Tuberosity; Trochanter; Knee; Malleolus; Heel; Toe. The anatomical regions registered in Portugal but not part of the recommended EPUAP and NPUAP regions were included in the category "Others".
The variable age was divided in seven groups, namely 18-29, 30-39, 40-49, 50-59, 60-69, 70-79 and ≥ 80 years old.

Data Analysis

Data were analysed using the Statistical Package for the Social Sciences (SPSS) software, version 21.0. Descriptive statistics were calculated for the demographic and clinical variables and sample characterization. Overall prevalence and the prevalence in the different groups were calculated as [(number of participants with a pressure ulcer / number of participants in a population at a particular point of time) x 100] (Defloor et al., 2005).

Normal distribution of the data was assessed with Kolmogorov-Smirnov test. As the data were not normally distributed we used non-parametric tests (Mann-Whitney and Kruskal-Wallis) for comparison of means. Odds ratio (OR) were calculated by univariate logistic regression.

RESULTS

This study included 7132 participants, 52% were male and 48% were female, with the mean age 65.8 ± 18.1 years (mean ± SD). The majority of participants were admitted from emergency service (71%) to surgical (66%) or medical (34%) units (Table 1.C2). The participants were grouped according to the International Classification of Diseases Version 9 (ICD-9) as the following diagnoses group: Digestive (20%); Respiratory (13%); Musculoskeletal (10%), Genitourinary (9%), Cardiac (9%), Vascular (9%), Traumatisms/Fractures (8%), Neoplasms (7%), Infectious (3%), Endocrine/Metabolic (2%), Central Nervous (2%), Skin (2%), Hematologic (1%) and Others (5%).

At the first pressure ulcer risk assessment 2333 (32.7%) of the participants were classified as "at risk of developing pressure ulcer" (Braden Scale score ≤ 16) and at the first skin assessment 560 (7.9%) participants had at least one pressure ulcer documented.

Using a univariate logistic regression model, having a pressure ulcer was significantly associated with gender, admission, specialty, dichotomized Braden Scale score, group age, patient discharge (table 1.C2) or diagnosis (Figure 1.C2).

At the first skin assessment, 6.8% of the men and 9.0% of the women had (at least) one pressure ulcer category/stage I-IV [OR 1.36 (95% CI, 1.15-1.62)]. Only 0.4% of the

participants with a programed admission had (at least) a pressure ulcer at the first skin assessment while 10.8% of the participants with an emergency service admission had at least one pressure ulcer documented [OR 27.29 (95% CI, 14.09-52.82)]. Only 2.6% of the participants of surgical units had (at least) one pressure ulcer at the first skin assessment while 16.0% of the participants of medical units had (at least) one pressure ulcer documented [OR 7.05 (95% CI, 5.71-8.71)].

Considering only the 2333 participants classified as "at risk of developing a pressure ulcer" (Braden Scale score ≤ 16), 539 participants (23.1%) had at least one pressure ulcer documented. So, the odds of having a pressure ulcer at the first skin assessment were significantly higher [OR 68.36 (95% CI, 44.06-106.07)] for the participants with Braden Scale Scores ≤ 16.

Also, the odds of having a pressure ulcer documented in the first skin assessment increased with age and were significantly higher in the categories over 60 years old, particularly in the group age ≥ 80 years old [OR 85.77 (95% CI, 12.00-616.677)], compared with the category of 18-29 years old.

Considering the patient discharge outcome, we found that among the 560 participants who had (at least) one pressure ulcer at the first skin assessment 126 (22.5%) died during the length of stay, 140 (25.0%) were discharged and 294 (52.5%) were transferred to other hospital/institution.

Considering ICD-9 diagnoses, the prevalence of participants with pressure ulcer was higher in the participants diagnosed with respiratory (27%), infectious (21%) and genitourinary system (13%) diseases (Figure 1.C2).

Among the 560 participants with pressure ulcer, 60.4% had two or more pressure ulcers, with a total of 1455 pressure ulcers category/stage I-IV recorded at the first skin assessment in inpatient setting during 2012. Most of the pressure ulcers recorded (42.3%) were category/stage I. The most frequent anatomical locations were the heels (28.9%), the sacrum/coccyx (22.4%) and the trochanters (12.4%) (Table 2.C2).

DISCUSSION

Our study investigated the patients hospitalized in medical and surgical areas of Aveiro Hospital and analysed the characteristics of participants that already had (at least) one pressure ulcer at the first skin assessment in inpatient setting.

Pressure ulcer risk

Considering the cut-off point of 16, established by Portuguese guidelines (DGS, 2011), the participants classified as “at risk of developing pressure ulcers” at the first pressure ulcer risk assessment comprises approximately one third of the study population. Similar results were reported in other studies (Ferreira, Miguéns, Gouveia, & Furtado, 2007; Sardo et al., 2015; Vanderwee, Clark, et al., 2007) in Portuguese hospitals. If we considered the cut-off point of 18, used in other international studies (Lahmann, Halfens, & Dassen, 2005; Tubaishat, Anthony, & Saleh, 2011; Uzun & Tan, 2007), more than a half of our participants would be classified as “at risk of developing pressure ulcers”.

If we considered only the participants classified as “at risk of developing a pressure ulcer”, approximately one fourth of them (23.1%) had at least one pressure ulcer documented in the first skin assessment. On the other hand, if we only considered the participants classified as “not at risk of developing a pressure ulcer” we realize that only 21 participants (0.4%) had a pressure ulcer documented in the first skin assessment. In fact, in our sample the participants classified as “at risk of developing a pressure ulcer” are the ones with higher odds of having (at least) one pressure ulcer at the first skin assessment.

Pressure ulcer point prevalence

Our study showed a point prevalence of participants with pressure ulcers of 7.9% category/stage I-IV at the first skin assessment in inpatient setting. Similar results (7.8%) were reported in a prospective study (Dugaret et al., 2014) in an Emergency Department in France and in a point prevalence study (Mehta, George, Mehta, & Wangmo, 2015) in a tertiary Hospital of India.

A multicentre study (Ferreira et al., 2007) developed in 8 Portuguese hospitals showed a higher prevalence of participants with pressure ulcer (11.5%) category/stage I-IV. That data reflected the first skin assessment in each institution but their sample included participants of Critical Care Services (Intensive Care Units and Emergency Room).

A multicentre survey (Vanderwee, Clark, et al., 2007) developed in 25 hospital sites across 5 European countries reported an overall point prevalence of participants with pressure ulcer of 18.1% (Category/Stage I-IV) and a point prevalence of participants with pressure ulcer in 3 Portuguese hospitals of 12.5% (Category/Stage I-IV). However, it also included a large sample of “Intensive” and “Acute Care / High Dependence” participants and the data did not reflect the first skin assessment in inpatient setting.

As far as Portuguese Islands studies (Silva et al., 2013) were concerned, a prevalence

participants with pressure ulcers of 9.0% in Azores and 22.7% in Madeira was reported. However, these data included participants from different care settings, namely hospitals, primary care facilities and nursing homes.
National (Ferreira et al., 2007; Silva et al., 2013; Vanderwee, Clark, et al., 2007) and international (Kottner, Wilborn, Dassen, & Lahmann, 2009; Mehta et al., 2015; Phillips & Clark, 2010; Vanderwee, Clark, et al., 2007) study reports on pressure ulcer prevalence had specific methodological approaches and different variables in analysis / involved, nevertheless highest prevalence usually were reported in Intensive Care Units and Geriatric wards (Beeckman, Defloor, Schoonhoven, & Vanderwee, 2011; Ferreira et al., 2007; Lahmann et al., 2005; Vanderwee, Clark, et al., 2007) showing the influence of illness severity (Beeckman et al., 2011; Cremasco, Wenzel, Zanei, & Whitaker, 2013) and age (Cox, 2011) in this specific domain.

The presence of pressure ulcers could be a measure of frailty, and, in our study, the highest odds of having a pressure ulcer at the first skin assessment in inpatient setting were associated with advanced age or lower Braden Scale scores.

According to ICD-9 Diagnosis, our results showed that participants with respiratory, infectious or genitourinary system diseases were the ones with higher percentage of pressure ulcers at the first skin assessment in inpatient setting. In fact, acute respiratory failure (Tescher, Branda, Byrne, & Naessens, 2012), respiratory diseases (Amir, Meijers, & Halfens, 2011) and infections (Amir et al., 2011; Cox, 2011) had already been documented to be associated with patients' (risk of) pressure ulcer presence/development.

Pressure ulcer category/stage

At the first skin assessment in inpatient setting most of the pressure ulcers (42.3%) were classified in category/stage I. These results were significantly higher than the ones reported in Portuguese hospitals (Ferreira et al., 2007) where only 18.3% of the pressure ulcers identified were category/stage I. Some authors (Ferreira et al., 2007; Lahmann et al., 2005) suggest that there may be a lack of identification and/or documentation of pressure ulcers in some study reports, especially category/stage I. So we believe that this difference could be the result of the improvement in skin assessment, pressure ulcer assessment, classification and documentation during the last years.

We have a significantly lower percentage of pressure ulcers category/stage IV (26.8%) compared to other study (Ferreira et al., 2007) which reported a percentage of 36.5% pressure ulcers category/stage IV in Portuguese hospitals. However, our numbers still

represent more than one fourth of all pressure ulcers documented, with all the costs and care needs associated.

Pressure ulcer location

The most frequent anatomical locations for the pressure ulcers were the heels (28.9% category/stage I-IV) and the sacrum/coccyx (22.4% category/stage I-IV). These two locations together comprise a half of all pressure ulcers documented at the first skin assessment in inpatient setting. Similar results were reported in Portuguese hospitals (Ferreira et al., 2007; Vanderwee, Clark, et al., 2007) where the heels and the sacrum/coccyx were the most problematic areas. However, in other countries, namely in UK (Stevenson et al., 2013; Vanderwee, Clark, et al., 2007), Italy (Vanderwee, Clark, et al., 2007), India (Mehta et al., 2015), and Japan (Igarashi et al., 2013) the pressure ulcers at sacrum /coccyx were in larger number.

Study limitations

While the pressure ulcer risk and skin assessment was performed in a systematic way in inpatient settings that did not happen in emergency service.

Our data only included the first pressure ulcer risk and skin assessment in inpatient setting but did not follow up the participants during the length of stay.

There is lack of documentation related to pressure ulcer characteristics and our data only showed the pressure ulcer category/stage and anatomical location.

There are important variables and/or risk factors that may help us to improve our findings (namely co-morbidities, dependence level, therapeutics, anthropometric, physiological and/or biochemical data) that could be collected with different methodological designs and the implementation of new clinical and research tools.

Implications to future research

This study reported the prevalence of participants with (at least one) pressure ulcer at the first skin assessment in inpatient setting and highlighted some of their clinical and demographic characteristics. Our results showed that the participants with pressure ulcer at the first skin assessment in inpatient setting commonly had more than one pressure ulcer. In fact, the presence of (at least) one pressure ulcer is an important measure of frailty and could be an important predictor of the patient outcome. However, more studies are needed to document other characteristics of those who had and/or developed pressure ulcers during

the length of stay, their clinical evolution, their discharge outcome and the characteristics/evolution of the pressure ulcers themselves.

CONCLUSION

The results of our study showed a point prevalence of participants with pressure similar to other recent internationals studies. Most of the pressure ulcers recorded were category/stage I. The heels and the sacrum/coccyx were the most problematic areas. The presence of a pressure ulcer at the first skin assessment could be an important measure of frailty and the participants with pressure ulcer commonly had more than one documented pressure ulcer. The highest odds of having a pressure ulcer at the first skin assessment in inpatient setting were significantly associated with advanced age or lower Braden Scale scores or Emergency Service admission. The diagnoses of respiratory, infectious and genitourinary system diseases were the ones with higher prevalence rate of participants with pressure ulcer at the first skin assessment compered to other ICD-9 diagnosis.

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Table 1.C2 – Characterization of the study participants (n=7132). Characterization of the participants who had (at least) one pressure ulcer documented at the first skin assessment (n = 560). The odds ratio (OR) for having a pressure ulcer at the first skin assessment was presented for each variable.

Skin Assessment	All participants n = 7132 (100%)	Participants with PU n = 560 (7.9%)	OR (95% CI)
Gender			
Male	3716 (52%)	252	1
Female	3416 (48%)	308	1.36 (1.15-1.62)
Age			
18-29	342 (4.8%)	1	1
30-39	429 (6.0%)	5	4.02 (0.47-34.58)
40-49	621 (8.7%)	3	1.66 (0.72-15.98)
50-59	899 (12.6%)	14	5.39 (0.71-41.18)
60-69	1234 (17.3%)	31	8.79 (1.20-64.60)
70-79	1766 (24.8%)	136	28.45 (3.97-204.14)
≥80	1841 (25.8%)	370	85.77 (12.00-612.67)
Admission			
Programmed	2035 (29%)	9	1
Emergency service	5097 (71%)	551	27.29 (14.09-52.82)
Patient discharge			
Discharge	5314 (75%)	140	1
Decease	377 (5%)	126	9.43 (7.64-11.65)
Transference	1441(20%)	294	18.77 (14.31-24.63)
Specialty			
Surgery	4358 (66%)	115	1
Medicine	2774 (34%)	445	7.05 (5.71-8.71)
Braden Scale score			
> 16	4779 (67%)	21	1
≤ 16	2333 (33%)	539	68.36 (44.06-106.07)

Table 2.C2 – Pressure ulcers documented at the first skin assessment according to their category/stage, location and frequency of pressure ulcers per participant with pressure ulcer.

	Pressure ulcers	
	n = 1455	100%
Category/Stage		
I	616	42.3%
II	245	16.8%
III	204	14.0%
IV	390	26.8%
Anatomical Location		
Occiput	2	0.1%
Ear	24	1.6%
Scapula	7	0.5%
Spinous process	1	0.1%
Elbow	13	0.9%
Iliac crest	5	0.3%
Sacrum/coccyx	326	22.4%
Ischial tuberosity	6	0.4%
Trochanter	180	12.4%
Knee	9	0.6%
Malleolus	100	6.9%
Heel	421	28.9%
Toe	65	4.5%
Other	296	20.3%
Frequency of PU	**Participants with PU**	
1	222	39.6%
2	133	23.8%
3	83	14.8%
4	40	7.1%
≥ 5	82	14.6%
Ratio PU/Patient with PU	2.60	

Figure 1.C2

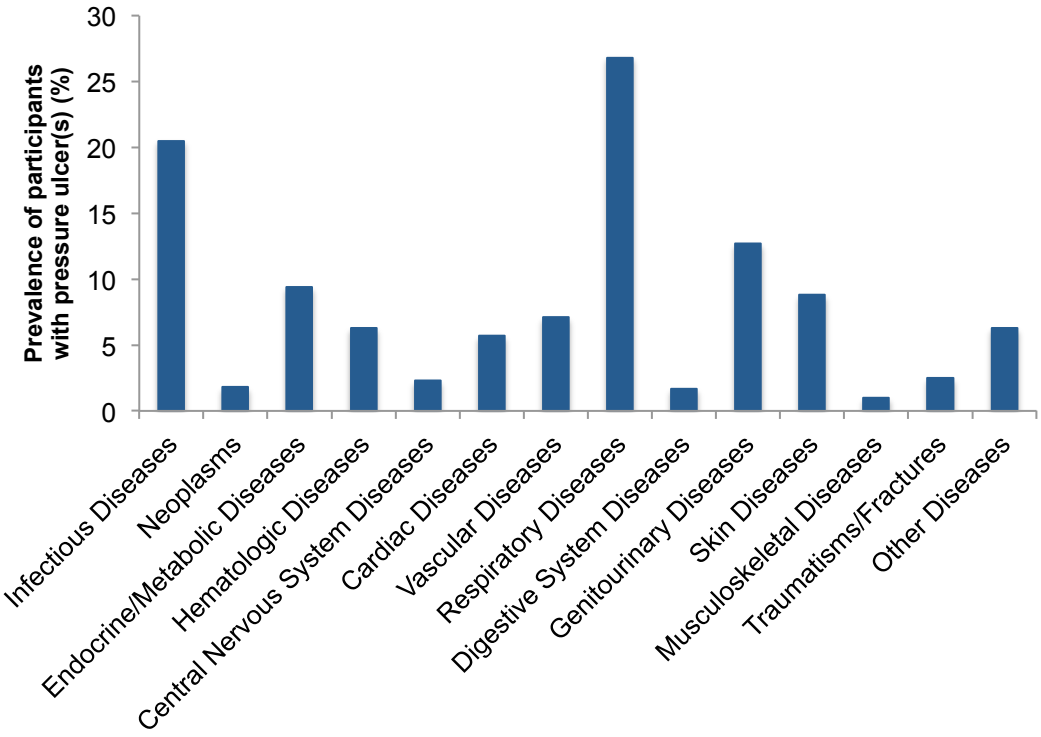

Figure 1.C2 – Frequency of participants with ulcer(s) grouped by the ICD-9 diagnosis.

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CHAPTER 3

PRESSURE ULCER INCIDENCE

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Analyses of pressure ulcer incidence in inpatient setting in a Portuguese hospital

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ANALYSES OF PRESSURE ULCER INCIDENCE

IN INPATIENT SETTING IN A PORTUGUESE HOSPITAL

ABSTRACT

Aim: To gain more insight into the magnitude of the problem of pressure ulcer incidence in general wards of a Portuguese hospital.

Material and methods: Retrospective cohort analysis of electronic health record database from 7132 adult patients admitted to medical and surgical wards of Aveiro Hospital during 2012. The development of (at least) one pressure ulcer during the length of stay was associated with age, gender, type of admission, specialty units, first Braden Scale score, length of stay, patient discharge outcome and ICD-9 diagnosis.

Results: An incidence of 3.4% participants with pressure ulcer category I-IV in inpatient setting during 2012. During the length of stay, 320 new pressure ulcers were developed, most of them category/stage II. The sacrum/coccyx and the trochanters were the most problematic areas.

Conclusions: The major risk factor for the development of a new pressure ulcer during the length of stay was the presence of (at least) one pressure ulcer at the first skin assessment. The length of stay itself, age and lower Braden Scale scores of our participants also played an important role in the odds of developing a pressure ulcer. Infectious diseases, traumatism and fractures and respiratory diseases were the ICD-9 diagnoses with higher frequency of participants that developed (at least) one pressure ulcer during the length of stay. It´s important to standardize procedures and documentation in all care settings. The documentation of nursing interventions is vital to evaluate the impact of evidence-based nursing.

KEYWORDS

Incidence; Nursing; Nursing Assessment; Pressure Ulcer; Prevalence; Risk Assessment

HIGHLIGHTS

Pressure ulcer (risk) assessment in Portugal.

Incidence of participants with pressure ulcers of 3.4%.

Most of the pressure ulcers developed were category/stage II.

The most problematic areas were the sacrum/coccyx and trochanters.

Pressure ulcer(s) presence at the first skin assessment is a measure of frailty.

INTRODUCTION

Pressure ulcers continue to be a challenge worldwide (Coleman, Nelson, et al., 2014; Coleman, Nixon, et al., 2014; Coleman, Smith, Nixon, Wilson, & Brown, 2016; NPUAP, EPUAP, & PPPIA, 2014; Smith, Nixon, Brown, Wilson, & Coleman, 2016) and represent an indicator of healthcare quality (Dealey et al., 2012; Hopkins, 2012; Moore, Cowman, & Posnett, 2013; Silva et al., 2013). Nowadays there are several studies on pressure ulcer prevalence (Amir, Meijers, & Halfens, 2011; Bredesen, Bjoro, Gunningberg, & Hofoss, 2015; Gallagher et al., 2008; Kottner, Wilborn, Dassen, & Lahmann, 2009; Mehta, George, Mehta, & Wangmo, 2015; Moore & Cowman, 2012; Schoonhoven, Bousema, & Buskens, 2007; Stevenson et al., 2013; Tubaishat, Anthony, & Saleh, 2011; Vanderwee, Clark, Dealey, Gunningberg, & Defloor, 2007) and/or incidence (Campanili, Santos, Strazzieri-Pulido, Thomaz, & Nogueira, 2015; Cox, 2011; Cremasco, Wenzel, Zanei, & Whitaker, 2013; Dugaret et al., 2014; Igarashi et al., 2013; Jenkins & O'Neal, 2010; Kwong, Pang, Aboo, & Law, 2009; Manzano et al., 2010; Schoonhoven et al., 2007; Tescher, Branda, Byrne, & Naessens, 2012) developed in different countries and in different care settings, however data about Portuguese reality and/or general wards are still few.

This paper is just one step of a larger project that aims to gain more insight into the magnitude of the problem of pressure ulcer risk, prevalence, incidence and management in Portugal. Our results will be very important epidemiological data that will guide us on the development of a preventive/intervention protocol based on institutional reality and patients' characteristics.

Recent studies in a Portuguese hospital analysed the characteristics of patients classified as "at risk" of developing a pressure ulcer during the length of stay (Sardo et al., 2015) and the characteristics of participants with (at least) one documented pressure ulcer at the first skin assessment (Sardo, Simões, Alvarelhão, Costa, et al., 2016). Nevertheless, there is a lack of knowledge about pressure ulcer incidence in Portuguese hospitals and/or general wards, the category/stage and anatomical location of those hospital acquired pressure ulcers, and the characteristics of patients who developed pressure ulcers during the length of inpatient stay.

In order to overcome these gaps, and following EPUAP statement (Defloor et al., 2005), the main aim of this study was to gain more insight into the magnitude of the problem of pressure ulcer incidence in general wards of a Portuguese hospital.

Specific objectives were defined as: [1] To calculate the incidence of pressure ulcers in hospitalised adult patients; [2] To identify the category/stage of pressure ulcers developed during the length of inpatient stay; [3] To identify the anatomical location of pressure ulcers

developed during the length of inpatient stay. [4] To analyse the demographic and clinical characteristics of hospitalised adult patients who developed pressure ulcers during the length of inpatient stay.

MATERIAL AND METHODS

Design

This study was designed as a retrospective cohort analysis of electronic health record database from adult patients admitted to medical and surgical wards of Aveiro Hospital from January 1, 2012 to December 31, 2012.

Sample / participants

The inclusion criteria were: [1] Patients aged ≥ 18 years at the time of admission; [2] Patients admitted and discharged in 2012; [3] Patients admitted through emergency service or with programmed hospital admission. The exclusion criteria were: [1] Patients with less than 24 hours' length of inpatient stay; [2] Patients admitted to specialties of Psychiatry, Gynaecology, Obstetrics and Intensive Care; [3] Patients without pressure ulcer risk assessment and/or skin assessment at admission in inpatient setting.

Ethical issues and approval

The study was performed after Hospital Council Board and Ethics Committee approval. Confidentiality of the participants was maintained and no names or identifying information was recorded.

Data collection

The data were extracted from electronic health record database with the collaboration of Hospital Informatics and Systems Analysis Service and included the following variables: first pressure ulcer risk assessment (first Braden Scale score), skin assessment records (all Skin Assessment Tool records during the length of inpatient stay), age, gender, type of admission (emergency service or programmed), specialty unit (medical or surgical), length of inpatient stay, patient discharge outcome (discharge, decease or transference to other hospital/health institution) and diagnosis.

Following national (DGS, 2011) and international (NPUAP et al., 2014) guidelines the pressure ulcer risk assessment (using the Portuguese version of Braden Scale) and the skin integrity assessment (using the skin assessment tool proposed by the national guideline) were performed by a registered nurse and/or a clinical nurse specialist at admission in

inpatient setting and were documented in the patient electronic health record. The risk and skin assessment are updated every 48 hours since the admission in inpatient setting until the patient discharge.

The Braden Scale scores (ranging from 6 to 23) were dichotomized according to national guideline (DGS, 2011) in participants “at risk” of developing pressure ulcers (Braden Scale score ≤ 16) and participants classified as “not at risk” of developing pressure ulcers (Braden Scale score > 16).

The skin assessment records included the category/stage and the anatomical location of the pressure ulcer. The category/stage was based on the pressure ulcer staging system of the National Pressure Ulcer Advisory Panel (NPUAP) and the European Pressure Ulcer Advisory Panel (EPUAP), which includes: Category/Stage I: Non-blanchable erythema; Category/Stage II: Partial thickness; Category/Stage III: Full thickness skin loss; Category/Stage IV: Full thickness tissue loss. The anatomical location was recorded according to national guidelines (DGS, 2011), which identify 29 areas of developing pressure ulcers, and were converted to the regions recommended by EPUAP and NPUAP, prior to the data analysis. Thus, the final location was organized into the following anatomical regions: Occiput; Ear; Scapula; Spinous Process; Shoulder; Elbow; Iliac Crest; Sacrum/Coccyx; Ischial Tuberosity; Trochanter; Knee; Malleolus; Heel; Toe. The anatomical regions registered in Skin Assessment Tool but not part of the recommended EPUAP and NPUAP regions were included in the category “Others”.

The variable age was divided in seven groups, namely 18-29, 30-39, 40-49, 50-59, 60-69, 70-79 and ≥ 80 years old. The variable length of stay was arbitrarily dichotomized according to a cut-off of 20 days of hospitalization. The diagnoses were grouped according to the International Classification of Diseases Version 9 (ICD-9).

Data analysis

Data were analysed using the Statistical Package for the Social Sciences software, version 21.0: IBM Corp; New York, USA. Descriptive statistics were calculated for the demographic and clinical variables and sample characterization. Following EPUAP statement (Defloor et al., 2005) pressure ulcer point prevalence was calculated as: [(number of participants with a pressure ulcer / number of participants in a population at a particular point of time) x 100]. Pressure ulcer period prevalence was calculated as: [(number of participants with a pressure ulcer / number of participants in a population during a particular period of time) x 100]. Pressure ulcer cumulative incidence was calculated as: [(number of participants developing

new pressure ulcers / number of participants (with or without pressure ulcers) in the population during the data collection period) x 100].

Odds ratio (OR) were calculated by univariate logistic regression.

RESULTS

Sample characterization

This study included 7132 participants, 52.1% were male and 47.9% were female, with the mean age of 65.8 ± 18.1 years (mean ± SD). The majority of participants were admitted from emergency service (71.5%) to surgical (61.1%) or medical (38.9%) units. According to the first pressure ulcer risk assessment in inpatient setting, 32.7% were classified as “at risk” of developing a pressure ulcer (Braden Scale score ≤ 16). The median length of inpatient stay was 6 days (Q25 = 3 days and Q75 = 10 days), being the maximum 134 days. Considering the patient discharge outcome, 74.5% of the participants were discharged, 20.2% were transferred to another hospital/health institution and 5.3% died during the length of stay (Table 1.C3).

The participants were grouped according to the ICD-9 as the following diseases: Digestive (20%); Respiratory (13%); Musculoskeletal (10%), Genitourinary (9%), Cardiac (9%), Vascular (9%), Traumatisms/Fractures (8%), Neoplasms (7%), Infectious (3%), Endocrine/Metabolic (2%), Central Nervous (2%), Skin (2%), Hematologic (1%) and Others (5%).

Pressure ulcer prevalence

Our sample included 560 (7.9%) participants with at least one pressure ulcer at the first skin assessment (point prevalence) being 539 of them (96.3%) classified as “at risk” of developing a pressure ulcer (Table 1.C3 and 2.C3).

If we consider all skin assessment records during 2012, 713 (10.0%) participants had (at least) one pressure ulcer documented (period prevalence) with 636 (89.2%) of them classified as “at risk” of developing a pressure ulcer.

Pressure ulcer incidence

During the length of inpatient stay, 241 participants developed (at least) one pressure ulcer, giving a pressure ulcer cumulative incidence of 3.4% at Aveiro Hospital in 2012. This number included 88 (36.5%) participants that already had (at least) one pressure ulcer at the first skin

assessment and 153 (63.5%) participants that developed the first pressure ulcer during the length of stay (Table 1.C3 and 2.C3).

If we only consider the 241 participants who developed pressure ulcers during the length of stay, 185 (76.8%) were classified as “at risk” of developing a pressure ulcer (Table 2.C3).

During 2012, 320 hospital acquired pressure ulcers were recorded. Most of those pressure ulcers (43.8%) were category/stage II. The sacrum/coccyx (35.6%), the trochanters (19.7%) and the heels (11.9%) were the most problematic areas (Table 3.C3).

Characteristics of the participants that developed pressure ulcer(s) during the length of stay

The participants that developed a new pressure ulcer during the length of inpatient stay differ from the ones that did not develop it in the variables: presence of pressure ulcer at first skin assessment, dichotomized length of inpatient stay, dichotomized Braden Scale score, type of admission, specialty units. Developing pressure ulcers was not different between genders (Table 1.C3).

Using a univariate logistic regression model, the odds of developing a pressure ulcer during the length of inpatient stay were higher for the participants that already had a pressure ulcer [OR = 7.82 (95% CI, 5.92-10.33)], with hospitalizations longer than 20 days [OR = 7.53 (95% CI, 5.70-9.95)], with Braden Scale scores ≤ 16 [OR = 7.30 (95% CI, 5.39-9.88)], admitted from emergency service [OR = 4.57 (95% CI, 2.88-7.024)] and/or staying in surgical units [OR = 1.61 (95% CI, 1.25-2.08)]. Older participants also had higher odds of developing a pressure ulcer, being statistically significant for the ones with group age 70-79 [OR = 6.70 (95% CI, 1.64-27.49)] and 80 or more [OR = 13.24; (95% CI, 3.26-53.74)] compared with the category of 18-29 years old (Table 1.C3).

Taking into account the ICD-9 diagnoses, the incidence of participants with pressure ulcer during the length of inpatient stay was higher in the participants diagnosed with infectious (7.9%), traumatisms and fractures (7.5%) and respiratory (6.8%) diseases (Figure 1.C3).

Pressure ulcers recorded during 2012

During 2012, 1775 pressure ulcers were recorded in medical and surgical wards of Aveiro Hospital. The participants with pressure ulcers commonly had more than one pressure ulcer and there was a ratio of 2.49 pressure ulcers per participant with pressure ulcer. Most of the pressure ulcers were category/stage I (39.9%) followed by category/stage IV (24.6%). The most frequent locations were the heels (25.9%) and the sacrum/coccyx (24.8%) (Table 3.C3).

DISCUSSION

To estimate incidence rates varies according to care setting, population studied, ulcer category/stage and methodologies used. Therefore, sometimes it is difficult to compare data at local, national and/or international level (Dealey et al., 2012; Dugaret et al., 2014; Moore & Cowman, 2012). Some studies that analysed the incidence of participants with pressure ulcers were developed in specific care settings, with acute care patients (Jenkins & O'Neal, 2010) in Intensive Care Units (Cox, 2011; Cremasco et al., 2013; Tescher et al., 2012) or in emergency departments (Dugaret et al., 2014) and the methodological designs were specific of those care settings.

Recent studies performed in NHS hospitals in England (Coleman et al., 2016; Smith et al., 2016) showed high levels of under-reporting for all pressure ulcer categories and provided some recommendations to improve care quality, patient safety and (future) pressure ulcer monitoring (Coleman et al., 2016).

In this study we were focused on the magnitude of the problem of the pressure ulcers that were effectively recorded and not on the nursing records reliability. Thus, using a retrospective cohort study, we investigated patients in medical and surgical wards of Aveiro Hospital and analysed the characteristics of participants that already had and/or developed a new pressure ulcer during the length of inpatient stay.

Pressure ulcer prevalence

Following EPUAP Statement (Defloor et al., 2005) we reported a point prevalence of participants with pressure ulcer of 7.9% category/stage I-IV at the first skin assessment in inpatient setting and a period prevalence of participants with pressure ulcer in inpatient setting of 10.0% during 2012. The characteristics of participants with (at least) one documented pressure ulcer at the first skin assessment in a Portuguese hospital were already analysed and discussed by Sardo, Simões, Alvarelhão, Costa, et al. (2016) in other study report.

Pressure ulcer incidence

Our study showed that 241 participants developed at least one pressure ulcer during the length of inpatient stay, giving a pressure ulcer cumulative incidence of 3.4% during 2012. Similar results (3.4%) were reported by Theisen, Drabik, and Stock (2012) in a retrospective observational study in a German hospital.

Our results were lower than the ones reported in Portugal (5.7%) by Ferreira, Miguéns, Gouveia, and Furtado (2007) and in France (4.9%) by Dugaret et al. (2014). The lowest

incidence rates reported in our study may be the outcome of the implementation of a national guideline on pressure ulcer risk assessment and skin assessment (DGS, 2011), and the subsequent efforts to improve pressure ulcer management in our hospital.

Cox (2011), Tescher et al. (2012) and Cremasco et al. (2013) developed their studies in Intensive Care Units and reported an incidence rate of 18.7% (category/stage I-IV), 3.3% (category/stage II-IV) and 34.4% (category/stage I-IV), respectively. Their sample (Cox, 2011; Cremasco et al., 2013; Tescher et al., 2012) excluded all the patients that already had a documented pressure ulcer and Tescher et al. (2012) did not include data related to pressure ulcer category/stage I.

Jenkins and O'Neal (2010) developed a cross-sectional study with adult medical, surgical, and intensive care patients and reported an incidence of participants with pressure ulcers that ranged from 0% to 5.4% (in different periods). Schoonhoven et al. (2007) performed a prospective cohort study in two hospitals in the Netherlands and reported an incidence of participants with pressure ulcers (category/stage II-IV) of 10.9%.

Our data did not include participants in critical care settings, which may explain the lower incidence rate. On the other hand, our data included a more diverse and heterogenic sample that reflected the reality of our hospital in medical and surgical wards during 365 days, and included pressure ulcers category/stage I-IV.

Pressure ulcer category/stage

During 2012, 1775 pressure ulcers were recorded in medical and surgical wards of Aveiro Hospital. Some authors (Coleman et al., 2016; Ferreira et al., 2007; Lahmann, Halfens, & Dassen, 2005; Smith et al., 2016) suggest that there may be a lack of identification and/or documentation of pressure ulcers in some study reports, especially pressure ulcer category/stage I. However, in our study, most of the pressure ulcers recorded were category/stage I, showing the effects of the skin assessment practice in early detection of changes in skin status/condition. Nevertheless, about one fourth of all pressure ulcers documented were category/stage IV, with all the care needs, direct and indirect costs (Demarre, Van Lancker, et al., 2015; Demarre, Verhaeghe, et al., 2015; Moore et al., 2013; Silva et al., 2013) associated.

Analysing the category/stage of all pressure ulcers developed during the length of inpatient stay, we found that almost half of them were category/stage II and more than one fourth were category/stage I. According to Lahmann and Kottner (2011) and Lahmann, Tannen, Dassen, and Kottner (2011) there is a statistically significant association between friction and shear forces and superficial wounds and Sardo et al. (2015) found that “activity” “mobility” and

"friction/shear forces" had higher contribution to Braden Scale score. Thus, the knowledge and management of these risk factors should have an important role in nursing care plan in order to improve patient outcomes.

However, more than one fourth of pressure ulcers developed during the length of stay revealed full thickness tissue loss (category/stage III and IV). According to Lahmann and Kottner (2011) such wounds had a statistically significant association with pressure forces. Therefore, the use of strategies and/or devices that help us reduce the pressure should also be taken into account.

Pressure ulcer anatomical location

As far as anatomical location is concerned we identified 3 critical areas in our participants during 2012: the heels, the sacrum/coccyx and the trochanters. Similar results were reported by Ferreira et al. (2007), Vanderwee et al. (2007) and Sardo, Simões, Alvarelhão, Costa, et al. (2016) in Portuguese hospitals.

When we analysed the anatomical location of new pressure ulcers the sacrum/coccyx and the trochanters assumed a special role with more than a half of all new pressure ulcers recorded. Similar results were reported by Cox (2011) in intensive care units in USA and by Igarashi et al. (2013) in long term care facilities in Japan.

Effectively, the sacrum/coccyx had already been described as the most vulnerable area for pressure ulcer development during the length of stay in different care settings, such as intensive care units (Campanili et al., 2015; Cox, 2011; Manzano et al., 2010), long term facilities (Igarashi et al., 2013; Kwong et al., 2009) and general wards (Schoonhoven et al., 2007; Vanderwee et al., 2007).

Characteristics of the participants that developed pressure ulcer(s) during the length of stay

Being admitted to a nursing home or a hospital is an important measure of frailty (Sardo, Simões, Alvarelhão, Simões, & Melo, 2016). Lower Braden scale scores (Sardo et al., 2015) and the presence of a pressure ulcer (Sardo, Simões, Alvarelhão, Costa, et al., 2016) could be an important predictor of patient outcome. Our results showed that the presence of (at least) one pressure ulcer at the first skin assessment in inpatient setting was the major risk factor for the development of a new pressure ulcer during the length of stay. The length of stay itself, age and/or lower Braden Scale scores of our participants also played an important role in the odds of developing a pressure ulcer.

Theisen et al. (2012) in a retrospective observational study in a German University Hospital concluded that incidence of pressure ulcers are an independent and a significant predictor of a prolonged length of stay for elderly patients. Some studies developed with intensive care patients already showed that the length of stay (Cox, 2011; Cremasco et al., 2013), age (Cremasco et al., 2013; Iranmanesh, Rafiei, & Sabzevari, 2012) and /or lower Braden Scale scores (Iranmanesh et al., 2012; Tescher et al., 2012) were important risk factors for pressure ulcer development.

The highest pressure ulcer prevalence rates were usually reported in intensive care units and in geriatric wards (Beeckman, Defloor, Schoonhoven, & Vanderwee, 2011; Dugaret et al., 2014; Ferreira et al., 2007; Vanderwee et al., 2007). Our study showed that most of the pressure ulcers recorded that year were in medical patients with advanced age.

However, some authors (Karadag & Gumuskaya, 2006; Schoonhoven, Defloor, & Grypdonck, 2002; Schoonhoven, Defloor, van der Tweel, Buskens, & Grypdonck, 2002) focus their attention on surgical patients and highlight their specific risk factors for pressure ulcer development. Schoonhoven (Schoonhoven et al., 2007) showed that pressure ulcer development during the hospital length of stay occurred more frequently in surgical patients compared to the medical, neurological and/or geriatric patients. Our data also showed the highest odds of surgical patients to develop pressure ulcer during the length of inpatient stay (when compared to medical patients).

On the other hand, diagnoses of infectious diseases, traumatism and fractures and respiratory diseases were the ones with higher frequency of participants that developed (at least) one pressure ulcer during the length of stay, compared to other ICD-9 diagnoses.

In fact, infectious (Amir et al., 2011; Cox, 2011; Sardo et al., 2015; Sardo, Simões, Alvarelhão, Costa, et al., 2016), traumatism and fractures (Ham, Schoonhoven, Schuurmans, & Leenen, 2014; Iranmanesh et al., 2012; Sardo et al., 2015) and respiratory diseases (Amir et al., 2011; Sardo et al., 2015; Sardo, Simões, Alvarelhão, Costa, et al., 2016; Tescher et al., 2012) had already been documented to be associated with patients' (risk of) pressure ulcer development.

Study limitations and implications to future research

In our study we were focused on the magnitude of the problem of pressure ulcers that were effectively recorded and not on the compliance with prevention guidelines/protocols and/or nursing records reliability. However, we would like to highlight some study limitations and some implications to future research.

At Aveiro Hospital the pressure ulcer risk assessment and skin assessment has been performed in a systematic way in medical and surgical wards since 2012. Regular audits to the nursing records have been performed since then and the results are communicated to nursing staff periodically in order to improve data record. However, pressure ulcer risk assessment, skin assessment and nursing records audits did not happen in emergency service and our data only showed the prevalence and incidence in inpatient settings.

There is no formal protocol in our hospital related to the implementation (and documentation) of preventive interventions/measures and we were not able to discuss if those interventions were (or were not) correctly implemented.

There is lack of documentation related to pressure ulcer characteristics and our data only showed the pressure ulcer category/stage and anatomical location.

We were not able to perform a multivariate analysis, which limits the evaluation of the associated factors with the development of a pressure ulcer during the length of inpatient stay.

We are aware that there are important risk factors that could be collected with different methodological designs. Based on these limitations we have already implemented new clinical and research tools that will allow us to analyse co-morbidities, dependence level, therapeutics, anthropometric, physiological and/or biochemical data of our patients, as well as nursing preventive interventions and pressure ulcer characteristics.

CONCLUSION

This study reported a point prevalence of participants with pressure ulcer of 7.9% at the first skin assessment in inpatient setting, a period prevalence of participants with pressure ulcer in inpatient setting of 10.0% during 2012 and a cumulative incidence of participants with pressure ulcer in inpatient setting of 3.4% in the same period.

From January 1st to December 31st, 2012, 320 new pressure ulcers were documented during the length of stay in medical and surgical wards, most of them category/stage II, followed by category/stage I. However, more than one fourth of pressure ulcers developed during the length of inpatient stay revealed full thickness tissue loss. The sacrum/coccyx and the trochanters were the most critical areas.

The major risk factor for the development of a new pressure ulcer during the length of inpatient stay was the presence of (at least) one pressure ulcer at the first skin assessment. The length of stay itself, age and/or lower Braden Scale scores of our participants also played an important role in the odds of developing a pressure ulcer.

Infectious diseases, traumatism and fractures and respiratory diseases were the ICD-9 diagnoses with higher frequency of participants that developed (at least) one pressure ulcer during the length of inpatient stay.

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Table 1.C3 – Characterization of the study participants (n=7132). Characterization of the participants who had (at least) one pressure ulcer documented at the first skin assessment in inpatient setting (n=560). Characterization of the participants who developed (at least) one pressure ulcer during the length of inpatient stays (n=241). The odds ratio (OR) for having and/or developing a pressure ulcer was presented for the variables gender, group age, type of admission, specialty unit, dichotomized Braden Scale score, dichotomized length of inpatient stay and patient discharge outcome.

	All participants	**Participants with PU at 1st skin assessment**		**Participants that developed PU during the length of stay**	
	n=7132 (100%)	n=560 (7.9%)	**OR (95% CI)**	n=241 (3.4%)	**OR (95% CI)**
Gender					
Male	3716 (52.1%)	252	1	118	1
Female	3416 (47.7%)	308	1.36 (1.15-1.62)	123	1.14 (0.88-1.47)
Group age					
18-29	342 (4.8%)	1	1	2	1***
30-39	429 (6.0%)	5	4.02 (0.47-34.58)	3	1.20 (0.20-7.21)
40-49	621 (8.7%)	3	1.66 (0.72-15.98)	2	0.55 (0.08-3.92)
50-59	899 (12.6%)	14	5.39 (0.71-41.18)	8	1.53 (0.32-7.22)
60-69	1234 (17.3%)	31	8.79 (1.20-64.60)	26	3.66 (0.86-15.49)
70-79	1766 (24.8%)	136	28.45 (3.97-204.14)	67	6.70 (1.64-27.49)
≥80	1841 (25.8%)	370	85.77 (12.00-612.67)	133	13.24 (3.26-53.74)
Type of admission					
Programmed	2035 (28.5%)	9	1	20	1***
Emergency service	5097 (71.5%)	551	27.29 (14.09-52.82)	221	4.57 (2.88-7.24)
Specialty unit					
Medicine	2774 (38.9%)	445	7.05 (5.71-8.71)	121	1***
Surgery	4358 (61.1%)	115	1	120	1.61 (1.25-2.08)
Braden Scale score					
> 16	4799 (67.3%)	21	1	56	1***
≤ 16	2333 (32.7%)	539	68.36 (44.06-106.07)	185	7.30 (5.39-9.88)
Length of inpatient stay					
< 20	6564 (92.0%)	463	1	154	1***
≥ 20	568 (8.0%)	97	2.71 (2.14-3.44)	87	7.53 (5.70-9.95)
Patient discharge outcome					
Discharge	5314 (74.5%)	140	1	105	1***
Decease	377 (5.3%)	126	9.43 (7.64-11.65)	54	8.29 (5.86-11.73)
Transference	1441(20.2%)	294	18.77 (14.31-24.63)	82	2.99 (2.23-4.02)

Table 2.C3 – Distribution of participants (n=7132) with or without pressure ulcer(s) during the length of inpatient stay grouped by risk level. Participants with Braden Scales score > 16 at the 1st pressure ulcer risk assessment were classified as "not at risk" of developing a pressure ulcer. Participants with Braden Scales score ≤ 16 at the 1st pressure ulcer risk assessment were classified as "at risk" of developing a pressure ulcer.

	Classified as "not at risk" of developing a pressure ulcer (Braden Scale score >16)	**Classified as "at risk" of developing a pressure ulcer (Braden Scale score ≤16)**	**Participants**
Participants	4799	2333	7132
Participants without pressure ulcer at 1st skin assessment	4778	1794	6572
Participants with pressure ulcer at 1st skin assessment	21	539	560
Participants with pressure ulcer at 1st skin assessment that developed a new PU during the length of stay	-	88	88
Participants without pressure ulcer at 1st skin assessment that developed the 1st PU during the length of stay	56	97	153
All participants that developed PU during the length of stay	56	185	241

Table 3.C3 – Distribution of pressure ulcers according to their category/stage and anatomical location. Ratio of pressure ulcers per participant with pressure ulcer. The distribution was calculated for all pressure ulcers recorded in 2012, for pressure ulcers identified at the first skin assessment in inpatient setting and for pressure ulcers developed during the length of inpatient stay.

	PU total		PU at 1st skin assessment		PU developed during the length of stay	
	n=1775	%	n=1455	%	n=320	%
Category/Stage						
I	708	39.9%	616	42.3%	92	28.8%
II	385	21.7%	245	16.8%	140	43.8%
III	246	13.9%	204	14.0%	42	13.1%
IV	436	24.6%	390	26.8%	46	14.1%
Anatomical Location						
Occiput	2	0.1%	2	0.1%	-	-
Ear	40	2.3%	24	1.6%	16	5.0%
Scapula	11	0.6%	7	0.5%	4	1.3%
Spinous process	3	0.2%	1	0.1%	2	0.6%
Elbow	25	1.4%	13	0.9%	12	3.8%
Iliac crest	7	0.4%	5	0.3%	2	0.6%
Sacrum/coccyx	440	24.8%	326	22.4%	114	35.6%
Ischial tuberosity	11	0.6%	6	0.4%	5	1.6%
Trochanter	243	13.7%	180	12.4%	63	17.7%
Knee	10	0.6%	9	0.6%	1	0.3%
Malleolus	107	6.0%	100	6.9%	7	2.2%
Heel	459	25.9%	421	28.9%	38	11.9%
Toe	71	4.0%	65	4.5%	6	1.9%
Other	346	19.5%	296	20.3%	50	15.6%
Ratio PU/patient						
	2.49		2.60		1.33	

Figure 1.C3

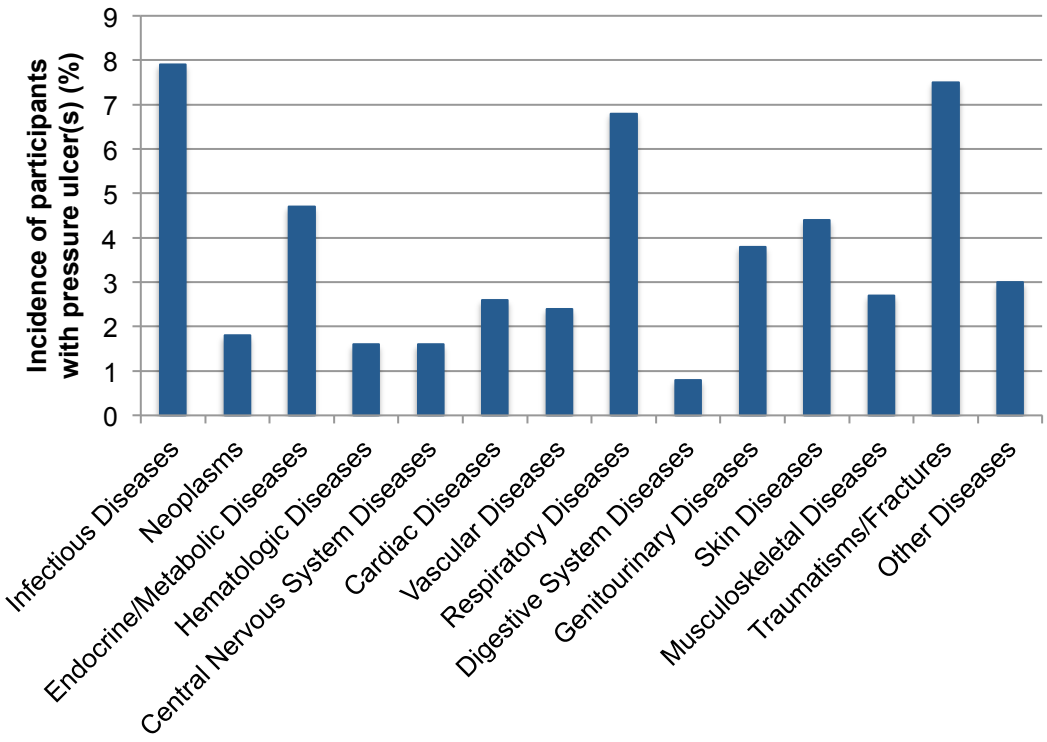

Figure 1.C3 – Frequency of participants who developed (at least) one pressure ulcer during the length of inpatient stay grouped by the ICD-9 diagnosis.

CHAPTER 4

DEVELOPMENT OF THE FIRST PRESSURE ULCER

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Pedro Sardo, Jenifer Guedes, João Simões, Paulo Machado and Elsa Melo

Development of the first pressure ulcer in inpatient setting:

Focus on patients' characteristics

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DEVELOPMENT OF THE FIRST PRESSURE ULCER IN INPATIENT SETTING: FOCUS ON PATIENTS' CHARACTERISTICS

INTODUCTION

Pressure ulcers continue to be a challenge and represent an indicator of healthcare quality.

OBJECTIVES

To analyse the incidence of the participants that developed their first pressure ulcer during the length of stay in association with their demographic and clinical characteristics.

METHODS

Retrospective cohort analysis of electronic health record database from adult patients, admitted to medical and surgical areas in a Portuguese hospital during 2012, without any pressure ulcer at the admission. The development of the first pressure ulcer was associated with age, gender, type of admission, specialty units, first Braden Scale score, length of inpatient stay and ICD-9 diagnosis.

RESULTS

From a sample of 6572 participants, 153 (2.3%) developed their first pressure ulcer and the odds were significantly higher for the ones admitted through the emergency service [OR=3.64 (95% CI, 2.20-6.05)], with Braden Scale scores ≤16 [OR=4.82 (95% CI, 3.45-6.73)] and/or with length of inpatient stay longer than 20 days [OR=8.35 (95% CI, 5.92-11.78)]. Older participants, with group age 70-79 [OR=9.87 (95% CI, 1.35-71.84)] and ≥80 [OR=17.75 (95% CI, 2.46-128.19)] also had higher odds. Participants with "traumatisms and fractures" and "infectious diseases" had higher incidence (6.6% and 5.3% respectively).

CONCLUSIONS

The participants that developed the first pressure ulcer during the length of stay differ from the ones that remain without pressure ulcers in the variables “admission”, “Braden Scale score”, “length of inpatient stay” and “age”. There were no differences between “gender” and “specialty units”. The ICD-9 diagnosis could be an important risk factor for pressure ulcer development.

KEYWORDS

Incidence; International Classification of Diseases; Nursing; Nursing Assessment; Pressure Ulcer; Risk Assessment.

Table 1.C4 – Sample characterization (n=6572). Characterization of the participants that developed the first pressure ulcer in inpatient setting (n=153). The odds ratio (OR) for developing the first pressure ulcer was presented for the variables gender, group age, type of admission, specialty unit, dichotomized Braden Scale score, dichotomized length of inpatient stay and patient discharge outcome.

	All participants	**Participants that developed the 1st PU during the length of inpatient stay**	
	n = 6572 (100%)	n = 153 (2.3%)	**OR (95% CI)**
Gender			
Male	3464 (52.7%)	75	1
Female	3108 (47.3%)	78	1.16 (0.84-1.60)
Group Age			
18-29	341 (5.2%)	1	1***
30-39	424 (6.5%)	2	1.61 (0.15-17.85)
40-49	618 (9.4%)	2	1.10 (0.10-12.22)
50-59	885 (13.5%)	7	2.71 (0.33-22.12)
60-69	1203 (18.3%)	22	6.33 (0.85-47.16)
70-79	1630 (24.8%)	46	9.87 (1.35-71.84)
≥80	1471 (22.4%)	73	17.75 (2.46-128.19)
Type of admission			
Programmed	2026 (30.8%)	17	1***
Emergency service	4546 (69.2%)	136	3.64 (2.20-6.05)
Specialty unit			
Medicine	2329 (35.4%)	57	1
Surgery	4243 (64.6%)	96	1.08 (0.78-1.51)
Braden Scale score			
> 16	4778 (72.7%)	56	1***
≤ 16	1794 (27.3%)	97	4.82 (3.45-6.73)
Length of inpatient stay			
< 20	6101 (92.8%)	97	1***
≥ 20	471 (7.2%)	56	8.35 (5.92-11.78)
Patient discharge outcome			
Discharge	5174 (78.7%)	84	1***
Decease	251 (3.8%)	34	9.54 (6.26-14.53)
Transference	1147(17.5%)	35	1.91 (1.28-2.84)

Table 2.C4 – Distribution of pressure ulcers according to their category/stage and anatomical location. Ratio of pressure ulcers per participant with pressure ulcer.

	Pressure ulcers	
	n = 173	100%
Category/Stage		
I	45	26.0%
II	87	50.3%
III	22	12.7%
IV	19	11.0%
Anatomical Location		
Occiput	-	-
Ear	3	1.7%
Scapula	-	-
Spinous process	2	1.2%
Elbow	3	1.7%
Iliac crest	-	-
Sacrum/coccyx	71	41.0%
Ischial tuberosity	-	-
Trochanter	20	11.6%
Knee	-	-
Malleolus	4	2.3%
Heel	19	11.0%
Toe	1	0.6%
Other	50	28.9%
Number of PU		
1	136	89%
2	14	9%
3	3	2%
Ratio PU/Patient with PU	1.13	

Pedro Sardo, Jenifer Guedes, João Simões, Paulo Machado and Elsa Melo

Development of the first pressure ulcer in inpatient setting: Focus on length of stay

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DEVELOPMENT OF THE FIRST PRESSURE ULCER IN INPATIENT SETTING: FOCUS ON LENGTH OF STAY

INTODUCTION

Pressure ulcer incidence represents an indicator of healthcare quality. Several instruments are used in clinical practice to assess and identify patients at risk of developing pressure ulcers, however the preventive interventions were not always fully implemented and the incidence of pressure ulcer in inpatient setting is still high. Some studies reported a correlation between pressure ulcer development and the length of stay.

OBJECTIVES

To identify the day of the first pressure ulcer development in inpatient setting.

METHODS

Retrospective cohort analysis of electronic health record database from adult patients, admitted to medical and surgical areas in a Portuguese hospital during 2012, without any pressure ulcer at the admission. The development of the first pressure ulcer was associated with the length of inpatient stay.

RESULTS

From a sample of 6572 participants, 153 (2.3%) developed their first pressure ulcer during the length of inpatient stay. The median length of stay was 6 days (Q25 = 3days; Q75 = 10 days), being the maximum 134 days. During the first week, 80 participants (52.3%) developed their first pressure ulcer. The highest frequency of participants that developed their first pressure ulcer occurred on the 5^{th} day (minimum 2^{nd} day; maximum 82^{nd} day) and the median was on the 7^{th} day.

CONCLUSIONS

Our study showed that the first week was particularly critical for pressure ulcer development and should be a period of highest nursing surveillance and preventive interventions. However, more studies are needed to better understand the correlation between time and pressure ulcer development.

KEYWORDS

Incidence; Length of Stay; Nursing; Nursing Assessment; Pressure Ulcer; Risk Assessment.

Figure 1.C4

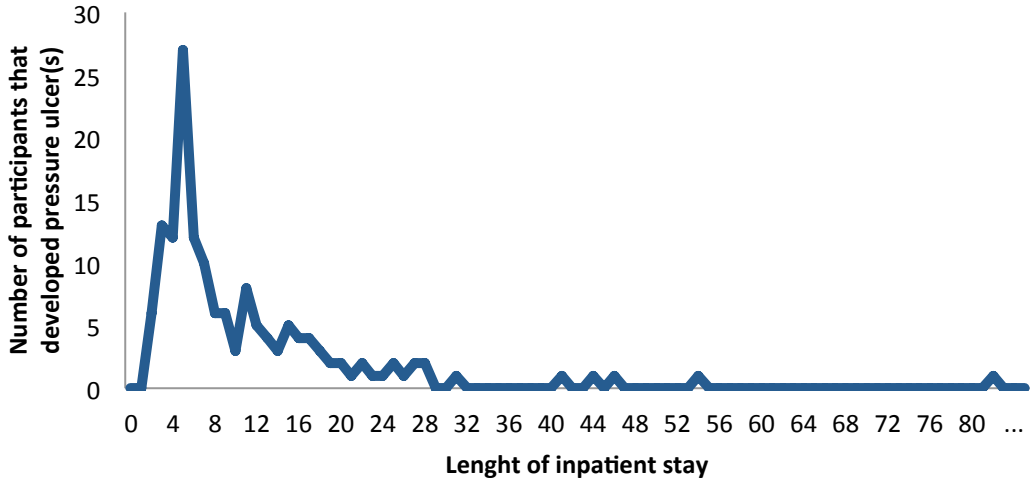

Figure 1.C4 – Frequency of participants that developed pressure(s) ulcer during the length of inpatient stay grouped according the day of pressure ulcer development.

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CHAPTER 5

FOCUS ON BRADEN SUBSCALES

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Pedro Sardo, Jenifer Guedes, José Alvarelhão, Paulo Machado and Elsa Melo

Development of the first pressure ulcer in inpatient setting:

Focus on Braden Subscales

(Manuscript submitted to peer review)

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DEVELOPMENT OF THE FIRST PRESSURE ULCER IN INPATIENT SETTING:

FOCUS ON BRADEN SUBSCALES

ABSTRACT

Background: Nurses need to manage several risk factors in order to prevent pressure ulcer development and should use each Braden subscale score as a guide of patients' specific risks. The investigation of the contribution of the Braden subscale scores has been limited and the findings have been inconclusive.

Aims: To determinate which Braden subscales are the best predictors of pressure ulcer incidence in hospitalised patients.

Methods: Retrospective cohort analysis of electronic health record database from adult patients admitted without pressure ulcer to general wards in a Portuguese Hospital during one year. Data were analysed using Cox regression (univariate and multivariate model) considering the length of inpatient stay since admission till the development of the first pressure ulcer.

Results/Findings: The univariate time to event analysis showed that all Braden subscales, except "nutrition", were associated with the development of pressure ulcer. By multivariate analysis the scores for "mobility" and "activity" were independently predictive of the development of pressure ulcer for all participants.

Discussion: The awareness of the existence of non-modifiable risk factors and the systematic use of risk assessment (scales) in order to manage specific modifiable risk factors could contribute to improve nursing care and patients' outcomes.

Linking evidence to action: Our study showed the influence of each Braden subscale on the development of pressure ulcer during the length of stay using a univariate and a multivariate time to event analysis.

Implications for practice: The total Braden Scale score should be used in combination with nursing clinical judgement in order to identify (all) patients at risk. Nurses should use each Braden subscale as a guide to the preventive nursing intervention**.**

Conclusions: (Im)“mobility” was the major risk factor for pressure ulcer development during the length of stay, for all participants, independently of the Braden Scale score.

Keywords:

Braden Scale, Incidence; Nursing; Nursing Assessment; Pressure Ulcer; Risk Assessment; Risk Factors.

STUDY'S BACKGROUND AND SIGNIFICANCE

The development of pressure ulcer(s) is complex and multifactorial (Cox, 2011) and nursing staff needs to manage several pressure ulcer risk factors (Coleman, Nelson, et al., 2014; Coleman, Nixon, et al., 2014) in order to prevent pressure ulcer development in inpatient settings.

Nowadays more than 30 risk assessment scales are known worldwide and are used in clinical practice (Defloor & Grypdonck, 2004, 2005; Kottner, Hauss, Schluer, & Dassen, 2013) but the prevalence and incidence of pressure ulcers in hospitals is still high (Beeckman, Defloor, Schoonhoven, & Vanderwee, 2011; Vanderwee, Grypdonck, & Defloor, 2007). Furthermore, due to the limited predictive power of the risk assessment tools, many patients designated as "at risk" do not develop pressure ulcers, even when the preventive measures are omitted, and a considerable number of patients designated as "not at risk" do develop pressure ulcers (Vanderwee, Grypdonck, & Defloor, 2007) with all the costs (Padula et al., 2015; Rycroft-Malone & McInnes, 2004; Silva et al., 2013) and care needs (Padula et al., 2015) associated.

The Braden Scale (Bergstrom, Braden, Laguzza, & Holman, 1987) had been tested in a largest number of studies, and demonstrated the best reliability and validity indicators in a variety of care settings (Pancorbo-Hidalgo, Garcia-Fernandez, Lopez-Medina, & Alvarez-Nieto, 2006).

Braden (2012) recommends that nurses should use each Braden subscale score as an initial appraisal of a patient's specific problems and functional deficits, as a flag for assessments that need to be further explored, and as a guide to the preventive interventions required. However, the investigation of the contribution of the Braden subscales scores has been limited and the findings have been inconclusive (Cox, 2011; Tescher, Branda, Byrne, & Naessens, 2012).

PURPOSE/AIMS

The purpose of our study was to determinate which Braden subscales are the best predictors of pressure ulcer incidence in adult patients admitted to medical and surgical areas in a general Portuguese hospital.

DESIGN

This study was designed as a retrospective cohort analysis of electronic health record database from adult patients admitted without any pressure ulcer to medical and surgical areas in a general Portuguese hospital during one year.

The inclusion criteria were: [1] Patients with ≥ 18 years old at the time of admission; [2] Patients admitted and discharged in 2012; [3] Patients admitted through emergency service or with programmed hospital admission [4] Patients without pressure ulcer(s) at the first skin and tissue assessment in inpatient setting. The exclusion criteria were: [1] Patients with less than 24 hours' length of stay; [2] Patients admitted to specialties of Psychiatry, Gynaecology, Obstetrics and Intensive Care; [3] Patients without pressure ulcer risk assessment and/or skin and tissue assessment at the admission in inpatient setting; [4] Patients with (at least) one pressure ulcer at the first skin and tissue assessment in inpatient setting.

METHODS AND JUSTIFICATION

The data were extracted from electronic health record database with the collaboration of Hospital Informatics and Systems Analysis Service and included the following variables: first pressure ulcer risk assessment (first Braden Scale score and Subscales scores), all skin and tissue assessment records (Skin Assessment Tool records during the length of inpatient stay), age, gender, type of admission (through emergency service or programmed hospital admission), specialty unit (medical or surgical) and length of inpatient stay.

The Braden Scale score ranges from 6 to 23 and is composed by 6 subscales: "sensory perception", "moisture", "activity", "mobility", "nutrition" and "friction/shear forces". Each subscale is rated 1 to 4, except for "friction/shear forces", which is rated 1 to 3 (the lowest value corresponds to a higher risk of developing pressure ulcers). The total score is used to predict overall risk of pressure ulcer development (Bergstrom, 2002; Bergstrom, Braden, Kemp, Champagne, & Ruby, 1998; Bergstrom et al., 1987) and each Subscale score should be used as a guide to the types of interventions that may be required (Braden, 2012).
The Skin Assessment Tool is composed by a body chart that identifies 29 different areas to assess the skin and tissue integrity and/or the presence of pressure ulcers, their location, size, depth and category/stage (DGS, 2011).
Following national (DGS, 2011) and international (NPUAP, EPUAP, & PPPIA, 2014) guidelines the pressure ulcer risk assessment (using the Portuguese version of Braden Scale) and the skin and tissue integrity assessment (using the Skin Assessment Tool proposed by the national guideline) were performed by a registered nurse and/or a clinical nurse specialist at admission in inpatient setting and were documented in the patient electronic health record. The risk assessment and the skin and tissue assessment were updated every 48 hours since the admission in inpatient setting until the patient discharge.
Thus, the participants were "categorized" into two levels of risk, defined by cut-off point of 16, as "at risk" of developing pressure ulcers (Braden Scale score ≤ 16) and as "not at risk" of developing pressure ulcers (Braden Scale score > 16).

The skin and tissue assessment records allowed to identify if the participants developed a pressure ulcer during the length of inpatient stay, its category/stage and the anatomical location.

ETHICAL ISSUES AND APPROVAL

The study was performed after Hospital Council Board and Ethics Committee approval. Confidentiality of the participants was kept.

STATISTICAL ANALYSES

Descriptive statistics were calculated for the demographic and clinical variables and sample characterization. Following EPUAP statement (Defloor et al., 2005), pressure ulcer incidence [(number of participants developing pressure ulcers / number of participants in the population during the data collection period) x 100] was calculated for all sample, for the participants classified as “at risk” of developing pressure ulcers (Braden Scale score ≤ 16) and for the participants classified as “not at risk” of developing pressure ulcers (Braden Scale score > 16).

Accuracy statistics tests such as sensitivity, specificity, positive and negative predictive value, positive and negative likelihood ratio and the area under the curve were assessed (Lalkhen & McCluskey, 2008).

Considering the length of inpatient stay since admission till the development of the first pressure ulcer, data were analysed using Cox regression, in a univariate model for each of variable of interest such as “age”, “gender”, “type of admission”, “specialty unit”, “total Braden Scale score” and “Braden subscales scores”. In the multivariate model only Braden subscale scores that were statistically significant were included. A concordance index was calculated to evaluate how well the model discriminated between participants with opposite outcomes. If a patient with a lower estimated hazard ratio had an event prior to one with a higher estimated hazard ratio, then the pair was classified as discordant. Otherwise the pair was considered concordant.

The procedures were executed using IBM SPSS Statistics for Apple, version 23.0. Armonk, New York, USA. In all analyses, a p-value < 0.05 indicated statistical significance.

RESULTS/FINDINGS

This study included 6552 participants, 52.6% were male, with the mean age of 64 years and 6 months. The majority of participants were admitted from emergency service (69.1%) to surgical (64.5%) units. The median length of inpatient stays was 6 days (Q25 = 3 days and

Q75 = 10 days), being the maximum 134 days. The mean length of stay was 8.1 days. According to the first pressure ulcer risk assessment in inpatient setting, 1774 (27.1%) participants were classified as “at risk” of developing a pressure ulcer (Braden Scale score ≤ 16) (Table 1.C5).

During the length of stay, 153 participants developed (at least) one pressure ulcer, giving a pressure ulcer incidence of 2.3% in inpatient setting during 2012. The incidence of participants with pressure ulcer by Braden Scale risk groups are presented in figure 1, showing an incidence of 1.2% for the participants with Braden Scale score > 16 and an incidence of 5.5% for the participants with Braden Scale score ≤ 16.

Considering the cut-off point of 16 established by Portuguese guidelines (DGS, 2011), the Braden Scale accuracy tests are presented in table 2.C5, showing a sensitivity of 63.4% (CI95%: 55.2%-71.0%) and a specificity of 73.8% (CI95%: 72.7%-74.9%).

When nursing staff identified the first hospital acquired pressure ulcer in the participants, most of them (n=136) developed only 1 pressure ulcer. In some cases (n=14) nursing staff identified 2 different pressure ulcers. Furthermore, in 3 cases nursing staff reported 3 different pressure ulcers, giving a total of 173 developed pressure ulcers.

According to table 3.C5, the pressure ulcers developed during the length of inpatient stay were mostly category/stage II (50.3%). The most frequent anatomical location was sacrum/coccyx (41.0%) followed by other locations (28.9%), trochanters (11.6%) and heels (11.0%).

Table 4.C5 presents the distribution of participants classified in each Braden subscale score at the first assessment. The incidence of participants that developed a pressure ulcer during the length of stay follows a linear function to each Braden subscale, except for “nutrition” and “moisture”.

Table 5.C5 presents the univariate time to event analyses and shows that the Hazard ratio of developing a pressure ulcer during the length of stay increased with the age (1.05; CI95%: 1.03-106) and with the decrease of Braden Scale scores (1.21; CI95%: 1.15-1.27).

The Hazard ratio was also higher for the participants admitted to surgical units (1.43; CI95%: 1.03-1.99) or with emergency service admission (1.75; CI95%: 1.05-2.90) when compared with admissions to medical units or programmed hospital admissions, respectively (Table 5.C5).

The Hazard ratio of developing a pressure ulcer during the length of inpatient stay was not different between genders (Table 5.C5).

The univariate time to event analysis showed that all Braden subscales, except “nutrition”, were associated with the development of pressure ulcer (Table 5.C5). By multivariate analysis the scores for “mobility” (2.08; CI95%: 1.61-2.68) and “activity” (1.24; CI95%: 1.02-1.52) were independently predictive of the development of pressure ulcers, for all participants (Table 6.C5).

If we only consider the participants classified as “at risk” of developing pressure ulcers at the first assessment, the scores for “mobility” (1.61; CI95%: 1.14-2.28) and “activity” (1.63; CI95%: 1.00-2.65) still are independently predictive of the development of pressure ulcers (Table 6.C5).

If we only consider the participants classified as “not at risk” of developing pressure ulcers at the first assessment, only the scores for “mobility” (3.20; CI95%: 2.03-5.04) are independently predictive of the development of pressure ulcers (Table 6.C5).

STUDY LIMITATIONS

This study was designed as a retrospective cohort analysis of electronic health record database and the limitations are due to data recording and database characteristics.

We understand that there are several pressure ulcer risk factors (like co-morbidities, dependence level, therapeutics, anthropometric, physiological and/or biochemical data of our patients) that could be collected with different methodological designs. However, the focus of this manuscript was on Braden subscales and on their influence for pressure ulcer development.

DISCUSSION

To estimate incidence rates varies according to care setting, population studied, pressure ulcer category/stage and methodologies used (Sardo, Simões, Alvarelhão, Simões, Machado, et al., 2016). Our study investigated patients in general wards in a general Portuguese hospital and (only) analysed the characteristics of participants that were admitted in medical and surgical wards without pressure ulcers at the time of admission.

Considering the cut-off point of 16 established by Portuguese guidelines (DGS, 2011), the participants classified as “at risk” of developing pressure ulcers at the first pressure ulcer risk assessment comprises more than one fourth (27.1%) of the study population.

Higher percentage of participants classified as “at risk” of developing pressure ulcers (32.7% to 34.4%) were reported in general wards in a Portuguese hospital, however their sample included participants that already had pressure ulcer(s) at the time of admission to inpatient

setting (Sardo et al., 2015; Sardo, Simões, Alvarelhão, Costa, et al., 2016; Sardo, Simões, Alvarelhão, Simões, Machado, et al., 2016).

Higher results (35.5% to 37.4%) were also reported in 25 European hospitals by Vanderwee, Clark, Dealey, Gunningberg, and Defloor (2007) and in 8 Portuguese hospitals by Ferreira, Miguéns, Gouveia, and Furtado (2007), but their sample included participants in critical care settings (like emergency services and or intensive care units) and/or participants that had already had (at least) one pressure ulcer documented at the time of admission.

Beeckman et al. (2011) in a survey developed in 94 nursing wards across 14 Belgian hospitals reported a similar percentage of participants (29.7%) classified as “at risk” of developing pressure ulcers. However, their sample included participants in critical care settings and/or with pressure ulcers at the time of admission.

Following EPUAP Statement (Defloor et al., 2005), we reported a cumulative incidence of participants with pressure ulcer category/stage I-IV of 2.3% during 2012. Our results were lower than the ones reported in other national and international studies. However (once again) our sample did not include participants in critical care settings and participants that had already had (at least) one pressure ulcer at the time of admission in inpatient setting.

During the length of inpatient stay, 153 participants developed at least one pressure ulcer, and, curiously, 56 (36.6%) of them were not classified as “at risk” at the first pressure ulcer risk assessment.

Our Braden Scale accuracy tests follow the trend of the results found in other works (Park, Choi, & Kang, 2015). They may also be considered inferior not only because our study was conducted in general wards in a general hospital (and not in specific services such as intensive care units) but also due to the fact that some studies used a lower cut-off value to identify patients “at risk” of developing pressure ulcers.

More than a half of the hospital acquired pressure ulcers were category/stage II, which were usually associated to friction and shear forces (Lahmann & Kottner, 2011; Lahmann, Tannen, Dassen, & Kottner, 2011) during the patient attempt to change the body position and/or patient repositioning by health care providers.

The sacrum/coccyx had already been described as the most vulnerable area for pressure ulcer development during the length of stay in different care settings, such as intensive care units (Campanili, Santos, Strazzieri-Pulido, Thomaz, & Nogueira, 2015; Cox, 2011; Manzano et al., 2010), long term facilities (Igarashi et al., 2013; Kwong, Pang, Aboo, & Law, 2009) and general wards (Sardo, Simões, Alvarelhão, Simões, Machado, et al., 2016; Schoonhoven,

Bousema, & Buskens, 2007; Vanderwee, Clark, et al., 2007). However, our results also showed that more than one fourth (28.9%) of these hospital acquired pressure ulcers were in other anatomical locations not specified on the skin assessment tool body chart proposed by the national guideline.

According to Sardo, Simões, Alvarelhão, Simões, and Melo (2016) being at a hospital is an important measure of frailty and there are several non-modifiable risk factors like age, gender, type or cause of admission, among others. The awareness of the existence of non-modifiable risk factors and the systematic use of risk assessment scales in order to manage specific modifiable risk factors could contribute to improve nursing care and patients' outcomes.

As far as pressure ulcer risk assessment scale was concerned, our data showed that whenever the total Braden Scale scores decreased, there was a statistically significant increase of the hazard of pressure ulcer development. Similar results were reported by Tescher et al. (2012) in intensive care units in USA, by Iranmanesh, Rafiei, and Sabzevari (2012) in trauma intensive care units in Iran and Sardo, Simões, Alvarelhão, Simões, Machado, et al. (2016) in general wards in a Portuguese hospital.

The univariate time to event analysis showed that all Braden subscales, except "nutrition", were associated with the development of pressure ulcer during the length of inpatient stay.

According to Cox (2011) and Tescher et al. (2012) the contribution of the Braden subscale scores has been limited and the findings have been inconclusive. However, some study reports described different correlations between pressure ulcer risk and pressure ulcer development or between each Braden subscale and pressure ulcer development.

Low "sensory perception" and high skin "moisture" (Tescher et al., 2012) had already been described as important risk factors for pressure ulcer development in intensive care units in USA. Contradictory findings were reported by Cox (2011) due to decreased levels of sensory perception experienced by all patients in his sample that may have rendered "sensory perception" to a non-significant risk factor. A possible explanation for the finding that the score on the Braden moisture subscale was not predictive of pressure ulcers in Cox (2011) study is the frequent use of indwelling devices that minimize skin exposure to moisture from urine (indwelling urinary catheters) and liquid stool (fecal containment devices).

Limited "activity" (that is, limited degree of physical activity) had already been described as an important risk factor for pressure ulcer development in retrospective studies in general hospitals in Dutch (Amir, Meijers, & Halfens, 2011) and in Portugal (Sardo et al., 2015).

The (im)"mobility" (that is, the lack of ability to change and control body position) had already been described as an important risk factor for pressure ulcer development in intensive care units in USA (Cox, 2011; Tescher et al., 2012) and in general wards in a Portuguese hospital (Sardo et al., 2015).

As far as "friction/shear forces" were concerned, Lahmann and Kottner (2011); Lahmann et al. (2011), Tescher et al. (2012) and Cox (2011) have already highlighted the contribution of this Braden subscale on pressure ulcer development, namely on the development of superficial wounds (Lahmann & Kottner, 2011; Lahmann et al., 2011).

Cox (2011), Tescher et al. (2012) and Sardo et al. (2015) reported that "nutrition" was not a significant predictor of pressure ulcers in intensive care units and/or general wards. However, nutrition or poor nutrition is a factor that predisposes the pressure ulcer development (Sharp & McLaws 2006). Some authors reported that patients with lower albumin levels (Anthony et al. 2000, Uzun &Tan 2007, Serra et al. 2013) and/or lower body mass index (Uzun & Tan 2007, Serra et al. 2013) have higher risk for pressure ulcer development. Thus, the low hazard ratio between "nutrition" subscale and the incidence of participants with pressure ulcers during the length of inpatient stay may indicate that nutrition has not been accessed objectively (Sharp & McLaws 2006). So we suggest the adoption of NPUAP et al. (2014) recommendations for nutritional assessment.

The multivariate time to event analysis showed that lower scores in "mobility" subscale were the major risk factor for pressure ulcer development during the length of stay for all participants, independently of the total Braden Scale score. Thus, the greatest efforts in managing pressure ulcer risk should be on "mobility" (Sharp & McLaws, 2006), independently of the total Braden Scale score.

IMPLICATIONS TO FUTURE RESEARCH

Pressure ulcers continue to be a challenge to healthcare professionals and institutions (NPUAP et al., 2014). Some authors developed their studies on pressure ulcer risk assessment (Coleman, Nelson, et al., 2014; Coleman, Nixon, et al., 2014) and on preventive nursing interventions such as repositioning (Moore & Cowman, 2015; Vanderwee, Grypdonck, De Bacquer, & Defloor, 2007; Woodhouse, Worsley, Voegeli, Schoonhoven, & Bader, 2015), nutrition (Posthauer, Banks, Dorner, & Schols, 2015; Serpa & Santos, 2014), support surfaces for pressure ulcer prevention (Demarre et al., 2013; Heyneman, Vanderwee, Grypdonck, & Defloor, 2009; Vanderwee, Grypdonck, & Defloor, 2008), the use of prophylactic dressings as an adjunct to pressure ulcer prevention (Black et al., 2015; Call et al., 2015; Clark et al., 2014) and/or the pressure ulcers direct and indirect costs

(Rodrigues, Ferre-Grau, & Ferreira, 2015; Rodrigues, Ferreira, & Ferre-Grau, 2016; Silva et al., 2013).

So, we should learn with those evidence studies and develop, implement and evaluate a preventive protocol based on international guidelines (NPUAP et al., 2014), institutional reality, patients' clinical and demographic characteristics and affected Braden subscales.

Recent studies in general wards in a Portuguese hospital (Sardo et al., 2015; Sardo, Simões, Alvarelhão, Costa, et al., 2016; Sardo, Simões, Alvarelhão, Simões, Machado, et al., 2016) analysed the characteristics of participants classified as "at risk" of developing a pressure ulcer during the length of stay, the characteristics of the participants with (at least) one documented pressure ulcer at the first skin assessment and the characteristics of the participants that developed a pressure ulcer during the length of inpatient stay, their category/stage and the anatomical location.

This new study showed the influence of each Braden subscale on the hazard of developing a pressure ulcer during the length of inpatient stay and highlighted that (im)"mobility" and (in)"activity" were the major risk factors assessed by Braden Scale. Thus, further studies are needed not only to understand the influence of the patients ability to change and control body position and their degree of physical activity on pressure ulcer (risk) development, but also to implement accurate nursing interventions in order to assist the patients dependence on those domains.

However, we (still) face several challenges. According to Doran et al. (2014) nurses are more likely to document patient assessment than nursing interventions. Nevertheless we believe that the documentation of nursing interventions and patients' outcomes are essential to evaluate the impact of evidence based nursing, to reduce health care costs and variations and (also/even) to improve patients' outcomes (Doran et al., 2014; Melnyk, 2015; Yang, Hung, Chen, Hu, & Shieh, 2012).

In our hospital, pressure ulcer risk assessment and skin and tissue assessment are performed in a systematic way in inpatient setting since 2012. However, there is no formal protocol related to the implementation of preventive measures adjusted to the risk level identified, and nursing staff (still) uses powered device in bed, non-powered device in bed and/or chair and repositioning every 2, 3 or 4 hours in a subjective way, based on individual judgment and individual experience.

So, we would like to highlight the need to standardize procedures and documentation as far as preventive care is concerned. On the other hand, in order to support (and improve) clinical documentation of patients' outcomes (Doran et al., 2014; Melnyk, 2015) we also suggest the

implementation of a validated tool that will help us to monitor pressure ulcer characteristics and its evolution during the length of stay. In fact, like Beal and Smith (2016) and Ramos-Morcillo, Fernandez-Salazar, Ruzafa-Martinez, and Del-Pino-Casado (2015), we believe that accurate data collection methods and evidence-based guidelines are vital to improve patient safety and the quality of nursing care.

LINKING EVIDENCE TO ACTION

- There are several (modifiable and non-modifiable) risk factors that should be managed by nursing staff in order to prevent pressure ulcer development.

- More than one fourth of the participants were classified as “at risk” of developing pressure ulcers (at the first pressure ulcer risk assessment), which should lead to the implementation of preventive nursing interventions.

- Despite the preventive measures applied, we reported an incidence of participants with pressure ulcers of 2.3% during the data collection period.

- More than a half of the hospital acquired pressure ulcers were category/stage II, which were usually associated to friction and shear forces during body repositioning.

- The sacrum/coccyx was the most problematic area for the pressure ulcer development during the length of inpatient stay.

- More than one fourth of first hospital acquired pressure ulcers were documented in “other locations” not specified in the Portuguese skin assessment tool body chart.

- The total Braden Scale score should be used in combination with nursing clinical judgement in order to identify patients “at risk” of developing pressure ulcers.

- Nurses should use each Braden subscale as a guide to nursing interventions.

- Nutritional assessment could not be accessed objectively and should be optimised following international guidelines.

- The greatest efforts in managing pressure ulcer risk should be on “mobility”, independently of the total Braden Scale score.

- In order to improve evidence based nursing we should develop a pressure ulcer preventive protocol based on international guidelines, institutional reality, patients’ characteristics and affected Braden subscales.

- The implementation of a validated tool will help us to monitor pressure ulcer characteristics and its evolution during the length of stay.

CONCLUSION

The development of pressure ulcer(s) is complex and multifactorial and nursing staff needs to manage several (modifiable and non-modifiable) risk factors in order to prevent pressure ulcer development in inpatient settings.

We believe that the systematic use of Braden Scale does not reduce the pressure ulcer incidence by itself. However, this pressure ulcer risk assessment scale is very important to guide nursing staff on the implementation of accurate preventive interventions according to the risk level identified and/or affected subscale and, consequently, to improve patients' outcomes (and nursing indicators).

In fact, as the total Braden Scale scores decreased, there was a statistically significant increase of the hazard of pressure ulcer development. However, some participants that were not classified as "at risk" of developing a pressure ulcer at the first pressure ulcer risk assessment, effectively, acquired a pressure ulcer during the length of inpatient stay.

The univariate time to event analysis showed that all Braden subscales, except "nutrition", were associated with the development of pressure ulcer during the length of inpatient stay.

The multivariate time to event analysis showed that (i)"mobility" (the lack of ability to change and control body position) was the major risk factor for pressure ulcer development during the length of stay, for all participants, independently of the Braden Scale score.

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Table 1.C5 – Sample characterisation (n=6552).

Patient characteristics (n=6552)	
Gender, n (%)	
Male	3 449 (52.6%)
Female	3 103 (47.4%)
Age in years, mean (SD)	64y 6m (18y 1m)
<55	1 789 (27.3%)
55-65	1 042 (15.9%)
65-75	1 409 (21.5%)
> 75	2 312 (35.3%)
Length of stay in days	
Mean (SD)	8.1 d (8.66 d)
Quartiles (Q25; Q50; Q75)	3d; 6d; 10d
Type of admission, n (%)	
Programmed	2 022 (30.9%)
Emergency Service	4 530 (69.1%)
Specialty, n (%)	
Surgical units	4 227 (64.5%)
Medical units	2 325 (35.5%)
Braden Scale score, n (%)	
BS score > 16	4778 (72.9%)
BS score ≤ 16	1774 (27.1.%)

Table 2.C5 – Results of Braden Scale accuracy tests.

	Value (CI 95%)
Sensitivity	63.4% (55.2%-71.0%)
Specificity	73.8% (72.7%-74.9%)
Positive likelihood ratio	2.4 (2.1-2.8)
Negative likelihood ratio	0.5 (0.4-0.6)
Positive predictive value	5.5% (4.5%-6.6%)
Negative predictive value	98.8% (98.5%-99.1%)
Area under the curve	0.69 (0.64-0.73)

Table 3.C5 – Distribution of pressure ulcers according to their category/stage and anatomical location. Number of pressure ulcers per participant that developed pressure ulcer. Ratio of pressure ulcers per participant that developed pressure ulcer.

	Pressure ulcers	
	n = 173	100%
Category/Stage		
I	45	26.0%
II	87	50.3%
III	22	12.7%
IV	19	11.0%
Anatomical Location		
Occiput	-	-
Ear	3	1.7%
Scapula	-	-
Spinous process	2	1.2%
Elbow	3	1.7%
Iliac crest	-	-
Sacrum/coccyx	71	41.0%
Ischial tuberosity	-	-
Trochanter	20	11.6%
Knee	-	-
Malleolus	4	2.3%
Heel	19	11.0%
Toe	1	0.6%
Other	50	28.9%
Number of PU		
1	136	89%
2	14	9%
3	3	2%
Ratio PU/Patient with PU	1.13	

Table 4.C5 – Distribution of participants for each Braden subscale.

Braden subscale / score		Total of participants	Total of participants that developed pressure ulcer during the length of stay
Sensory perception	1	59	7 (11.86%)
	2	286	17 (5.94%)
	3	2234	76 (3.4%)
	4	3973	53 (1.33%)
Moisture	1	104	3 (2.88%)
	2	140	9 (6.43%)
	3	1084	55 (5.07%)
	4	5224	86 (1.65%)
Activity	1	2068	93 (4.5%)
	2	886	25 (2.82%)
	3	1360	24 (1.76%)
	4	2238	11 (0.49%)
Mobility	1	49	5 (10.2%)
	2	893	65 (7.28%)
	3	2538	70 (2.76%)
	4	3072	13 (0.42%)
Nutrition	1	1127	14 (1.24%)
	2	481	18 (3.74%)
	3	4208	109 (2.59%)
	4	736	12 (1.63%)
Friction/shear forces	1	578	41 (7.09%)
	2	1883	76 (4.04%)
	3	4091	36 (0.88%)

Table 5.C5 – Univariate time to event analysis.

Univariate time to event analysis			
Variables	**Hazard ratio**	**CI 95%**	***p***
Age	1.05	1.03-1.06	<0.001
Gender			
Female	1		0.284
Male	0.84	0.61-1.16	
Specialty			
Medical units	1		< 0.05
Surgical units	1.43	1.03-1.99	
Type of admission			
Programmed	1		< 0.05
Emergency Service	1.75	1.05-2.90	
Braden Scale*	1.21	1.15-1.27	<0.001
Braden Subscales*			
Sensory perception	1.72	1.40-2.11	< 0.001
Moisture	1.38	1.14-1.68	< 0.01
Activity	1.67	1.42-1.96	< 0.001
Mobility	2.46	2.00-3.03	< 0.001
Nutrition	0.88	0.71-1.08	0.208
Friction/shear forces	2.06	1.67-2.54	< 0.001

* For Hazard ration analysis the score was inverted.

Table 6.C5 – Multivariate time to event analysis.

Multivariate time to event analysis

	Braden Subscales	β	Standard error	Hazard ratio	CI 95%	*p*	*c-index*
All sample (n=6552)	Mobility	0.90	0.11	2.46	2.00-3.03	<0.001	0.724
	Activity	0.22	0.10	1.24	1.02-1.52	<0.05	
Braden Scale score ≤16 (n=1774)	Mobility	0.54	0.18	1.71	1.21-2.41	<0.01	0.783
	Activity	0.49	0.25	1.63	1.00-2.65	0.05	
Braden Scale score >16 (n=4778)	Mobility	1.16	0.23	3.20	2.03-5.04	<0.001	0.778

Figure 1.C5

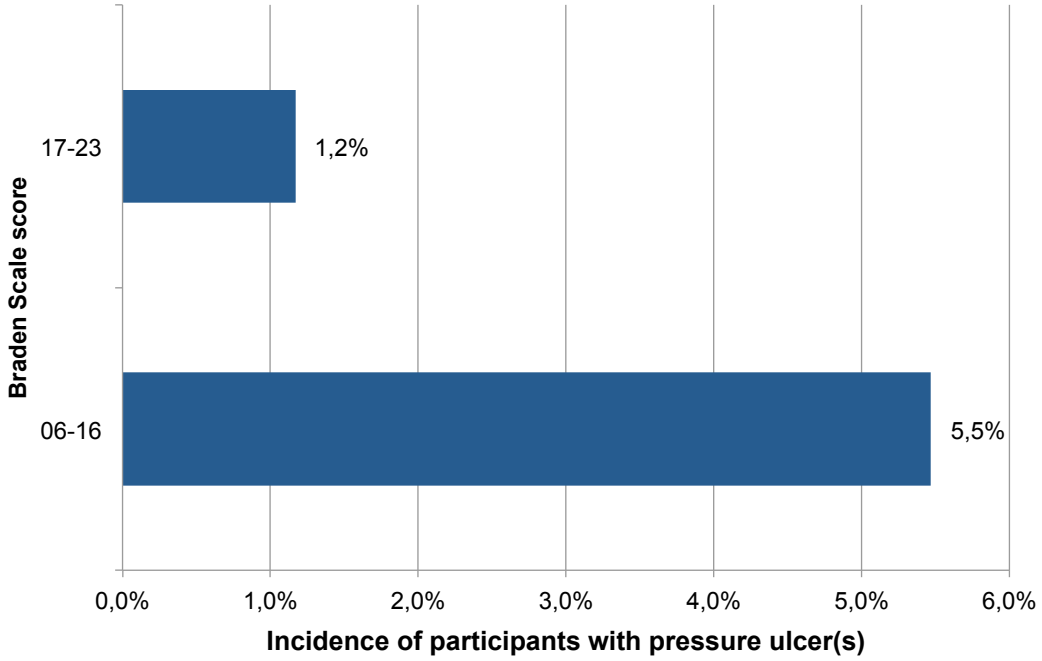

Figure 1.C5 – Incidence of participants with pressure ulcer(s) grouped by Braden Scale risk level.

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CHAPTER 6

GENERAL DISCUSSION

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Pedro Sardo, Paulo Machado and Elsa Melo

The magnitude of pressure ulcers problem (in general wards)

(Unpublished manuscript)

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THE MAGNITUDE OF PRESSURE ULCERS PROBLEM

(IN GENERAL WARDS)

INTRODUCTION

Pressure ulcers continue to be a challenge to all health care professionals and institutions and preventive strategies should (still) be discussed in a multidisciplinary way in order to improve patients' outcomes (Sardo et al., 2015; Sardo, Simões, Alvarelhão, Costa, et al., 2016; Sardo, Simões, Alvarelhão, Simões, Machado, et al., 2016).

Nowadays, national (DGS, 2011) and international (NPUAP, EPUAP, & PPPIA, 2014) guidelines give us some orientations about the "leges artis" on pressure ulcer management and provide important recommendations to/for clinical research and clinical practice.

There are several studies worldwide on **pressure ulcer risk assessment** (Chou et al., 2013; Pancorbo-Hidalgo, Garcia-Fernandez, Lopez-Medina, & Alvarez-Nieto, 2006; Papanikolaou, Lyne, & Anthony, 2007; Sharp & McLaws, 2006; Stechmiller et al., 2008), **pressure ulcer prevalence** (Amir, Meijers, & Halfens, 2011; Bredesen, Bjoro, Gunningberg, & Hofoss, 2015; Gallagher et al., 2008; Kottner, Wilborn, Dassen, & Lahmann, 2009; Mehta, George, Mehta, & Wangmo, 2015; Moore & Cowman, 2012; Schoonhoven, Bousema, & Buskens, 2007; Stevenson et al., 2013; Tubaishat, Anthony, & Saleh, 2011; Vanderwee, Clark, Dealey, Gunningberg, & Defloor, 2007) and/or **pressure ulcer incidence** (Campanili, Santos, Strazzieri-Pulido, Thomaz, & Nogueira, 2015; Cox, 2011; Cremasco, Wenzel, Zanei, & Whitaker, 2013; Dugaret et al., 2014; Igarashi et al., 2013; Jenkins & O'Neal, 2010; Kwong, Pang, Aboo, & Law, 2009; Manzano et al., 2010; Schoonhoven et al., 2007; Tescher, Branda, Byrne, & Naessens, 2012). **However, each study had a specific methodological design and provided us with a specific "point of view" about the magnitude of pressure ulcers problem in different care settings and in different realities.**

Some studies performed in general wards in a Portuguese hospital highlighted the characteristics of the participants classified as "at risk" of pressure ulcer development during the length of stay (Sardo et al., 2015); the characteristics of the participants that already had (at least) one pressure ulcer at the first skin and tissue assessment in inpatient setting (Sardo, Simões, Alvarelhão, Costa, et al., 2016); the characteristics of the participants that developed (at least) one pressure ulcer during the length of inpatient stay (Sardo, Simões,

Alvarelhão, Simões, Machado, et al., 2016); and the influence of each Braden subscale on pressure ulcer development (in review).

Those results were very important to improve our knowledge on the magnitude of pressure ulcers problem in general wards in a Portuguese hospital. In (a near) future we aim to develop, implement and evaluate a preventive protocol based on national and international guidelines, institutional reality, patients' clinical and demographic characteristics and affected Braden subscales.

In clinical research articles the results were usually discussed and compared to other clinical research reports and/or best clinical practices. In this chapter **we aimed to discuss our results** in a more direct and personal away (based on previous evidence studies and our clinical practice), highlighting our point of view in different domains and emphasising some aspects that should be taken into account by nurses when they plan and delivery care.

PRESSURE ULCER RISK ASSESSMENT

Although there is no evidence that the use of pressure ulcer risk assessment scales reduce the incidence of pressure ulcers by itself (Anthony, Parboteeah, Saleh, & Papanikolaou, 2008; Chou et al., 2013; Pancorbo-Hidalgo et al., 2006), the systematic use of pressure ulcer risk assessment scales allows the early identification of patients "at risk" and their specific risk factors (Braden, 2012).

International guidelines (NPUAP et al., 2014) state that risk assessment should be done using a validated tool (like Braden Scale) at the admission and should be reassessed if there is any change in the patient's condition.

National guidelines (DGS, 2011) encourage the implementation of regular pressure ulcer risk assessments through the application of the Portuguese version of Braden Scale (Attach 1). That assessment should be performed every 24 hours in emergency services and intensive care units. In inpatient settings that assessment should be performed at admission and repeated every 48 hours during the length of inpatient stay. It also recommends the patients' categorisation into two levels of risk, defined by cut-off point of 16, which should determine the implementation of preventive interventions.

Following Portuguese guidelines (DGS, 2011), Aveiro Hospital adopted the Portuguese version of Braden Scale to identify patients at risk of developing pressure ulcer(s). The assessments are performed (only) at admission in inpatient settings and repeated every 48 hours. Thus, patients with Braden Scale score ≤ 16 have a high risk of developing pressure

ulcer(s), and patients with a Braden Scale score > 16 have a lower risk of developing pressure ulcer(s).

Previous studies developed in Aveiro Hospital (Sardo et al., 2015; Sardo, Simões, Alvarelhão, Costa, et al., 2016; Sardo, Simões, Alvarelhão, Simões, Machado, et al., 2016) reported a significant percentage of participants classified as “at risk” of developing a pressure ulcer at admission in general wards, which was an important (nursing) indicator that could help us to plan nursing interventions and to manage human and material resources in order to prevent pressure ulcer development.

Almost three quarters of the patients were admitted to the inpatient setting through the emergency department (Sardo et al., 2015; Sardo, Simões, Alvarelhão, Costa, et al., 2016; Sardo, Simões, Alvarelhão, Simões, Machado, et al., 2016) and our clinical practice shows that the length of emergency service stay is, in several cases, over 24 hours. So, it is very important to improve our clinical practice and expand the systematic pressure ulcer risk assessment to the emergency department in order to identify patients “at risk” of pressure ulcer development since the beginning.

As far as inpatient setting is concerned, the systematic assessment of Braden Scale scores, besides assessing the pressure ulcer risk, might contribute to detect changes in the patient condition and could be used as a predictor of the length of inpatient stay (Sardo et al., 2015).

Thus, nurses should be aware that the Braden Scale scores were sensitive to the patient clinical worsening (or clinical improving) and the Braden subscale scores could reveal specific problems (specific risk factors) that should be taken into account by nurses during the clinical practice.

Although the pressure ulcer risk assessment is performed in a systematic way in inpatient setting, there is no formal protocol related to the implementation of preventive measures. Thus, nursing staff uses powered device in bed (alternating pressure mattress), non-powered device in bed (pressure relief mattress), powered device in chair (alternating pressure pillow), non-powered device in chair (pressure relief pillow) and/or repositioning every 2, 3 or 4 hours in a subjective way. So, we suggest the creation of a working group (composed by registered nurses and clinical nurses specialists from different departments) in order to develop a preventive protocol based on international guidelines, institutional reality, patients’ characteristics and affected Braden subscales. This protocol could be implemented in different departments, and will guide nursing staff planning and applying preventive interventions.

SKIN AND TISSUE ASSESSMENT

According to international guidelines (NPUAP et al., 2014) the skin and tissue assessment is an important step in pressure ulcer prevention, classification, diagnosis and treatment. In fact, a comprehensive skin and tissue assessment should be performed in all health care settings and should include techniques to identify blanching response, temperature changes, oedema, and changes in tissue consistency in relation to surrounding tissue (NPUAP et al., 2014). The skin under and around medical devices should also be inspected at least twice daily for the signs of pressure-related injury on the surrounding tissue (NPUAP et al., 2014).

National guidelines (DGS, 2011) encourage the implementation of regular skin and tissue assessments through the application of “Instrumento da Avaliação da Pele” (Attach 2). This is a skin assessment tool that allows the identification of skin integrity or the presence of pressure ulcer(s), their localisation (body chart with 29 possible areas), size, depth and category/stage. That assessment should be performed every 24 hours in emergency services and intensive care units. In inpatient settings that assessment should be performed at admission and repeated every 48 hours during the length of inpatient stay.

Following Portuguese guidelines (DGS, 2011), Aveiro Hospital adopted the “Instrumento da Avaliação da Pele” to perform (and record) the skin and tissue assessment. The evaluations are performed (only) in inpatient settings at admission and repeated every 48 hours. Although the skin and tissue assessment is performed in a systematic way, there is no formal assessment tool to record pressure ulcer characteristics and their evolution during the length of stay. So, we recommend the adoption of a validated tool to access each pressure ulcer. This will allow us to monitor the healing process, to monitor the effect of the performed treatments, to compare institutional data and to foment the evidence-based nursing.

PREVALENCE AND INCIDENCE

To estimate prevalence and incidence rates vary according to care setting, population studied, pressure ulcer category/stage and methodologies used (Dugaret et al., 2014).

Some studies developed in Aveiro Hospital reported a point prevalence of 7.9% participants with pressure ulcer(s) at the first skin and tissue assessment in inpatient setting (Sardo, Simões, Alvarelhão, Costa, et al., 2016); a period prevalence of 10.0% participants with pressure ulcer(s) in inpatient setting during 2012 (Sardo, Simões, Alvarelhão, Simões, Machado, et al., 2016) and a cumulative incidence of 3.4% participants with pressure ulcer(s) in inpatient setting during 2012 (Sardo, Simões, Alvarelhão, Simões, Machado, et al., 2016).

The prevalence rates reported by Sardo, Simões, Alvarelhão, Costa, et al. (2016) and Sardo, Simões, Alvarelhão, Simões, Machado, et al. (2016) followed the trend of other international studies (Dugaret et al., 2014; Mehta et al., 2015), but also showed an improvement when compared to previous national surveys (Ferreira, Miguéns, Gouveia, & Furtado, 2007; Vanderwee, Clark, et al., 2007).

The lower prevalence rates may be the outcome of the implementation of local and/or national programmes that aimed to "stop pressure ulcers". Those programmes have been implemented in health care institutions and/or community settings, namely through systematic pressure ulcer risk assessment and systematic skin and tissue assessment (in different care settings); through the continuous education of health care providers and the empowerment of the caregivers; and as result as some improvements on assistive equipment and supporting surfaces.

The incidence rate reported by Sardo, Simões, Alvarelhão, Simões, Machado, et al. (2016) was similar to other survey developed in general wards in a German hospital by Theisen, Drabik, and Stock (2012). However, it was lower than the incidence rates reported by Ferreira et al. (2007) and Schoonhoven et al. (2007) in general hospitals; by Dugaret et al. (2014) in emergency departments; and by Cox (2011), Tescher et al. (2012) and Cremasco et al. (2013) in intensive care units.

The lower incidence rate reported by Sardo, Simões, Alvarelhão, Simões, Machado, et al. (2016) may be the outcome of the implementation of a national guideline on pressure ulcer risk assessment and skin and tissue assessment (DGS, 2011), and the subsequent efforts to improve pressure ulcer management in Aveiro Hospital.

On the other hand, the study performed in Aveiro Hospital (Sardo, Simões, Alvarelhão, Simões, Machado, et al., 2016) did not include participants in critical care settings (such as emergency department and/or intensive care units), which could explain the lower incidence rate.

PRESSURE ULCER CATEGORY/STAGE

Some authors (Coleman, Smith, Nixon, Wilson, & Brown, 2016; Ferreira et al., 2007; Lahmann, Halfens, & Dassen, 2005; Smith, Nixon, Brown, Wilson, & Coleman, 2016) suggest that there may be a lack of identification and/or documentation of pressure ulcers in some study reports, especially pressure ulcer category/stage I.

Recent studies performed in NHS hospitals in England (Coleman et al., 2016; Smith et al., 2016) showed high levels of under-reporting for all pressure ulcer categories and provided

some recommendations to improve care quality, patient safety and (future) pressure ulcer monitoring (Coleman et al., 2016).

In our study, we were focused on the magnitude of the problem of the pressure ulcers that were effectively recorded and not on the nursing records reliability. Thus, using a retrospective cohort study, we analysed the category/stage recorded pressure ulcers.

Thus, about two fifths of the pressure ulcers documented at the first pressure ulcer skin and tissue assessment in inpatient setting were category/stage I (Sardo, Simões, Alvarelhão, Costa, et al., 2016), showing the effects of the skin and tissue assessment, performed at admission, in early detection of changes in skin status/condition.

Nevertheless, other two fifths of the pressure ulcers documented at the first pressure ulcer skin and tissue assessment in inpatient setting reveal full thickness tissue loss (Sardo, Simões, Alvarelhão, Costa, et al., 2016), with all the care needs, direct and indirect costs associated (Demarre, Van Lancker, et al., 2015; Demarre, Verhaeghe, et al., 2015; Moore, Cowman, & Posnett, 2013; Silva et al., 2013).

During the length of inpatient stay, almost half of the hospital acquired pressure ulcers reported by Sardo, Simões, Alvarelhão, Simões, Machado, et al. (2016) were category/stage II, which were usually associated to friction and shear forces (Lahmann & Kottner, 2011; Lahmann, Tannen, Dassen, & Kottner, 2011) during the patient attempt to change the body position and/or patient repositioning by health care providers. So, nurses should have special attention during the patient repositioning in order to reduce (and ideally eliminate) the friction and shear forces. This could also be an important (nursing) indicator that justifies the acquisition of repositioning equipment, the improvement of the supporting surfaces, the application of prophylactic dressings and/or improve nurse-to-patient staffing ratios.

On the other hand, more than one fourth of the hospital acquired pressure ulcers reported by Sardo, Simões, Alvarelhão, Simões, Machado, et al. (2016) reveal full thickness tissue loss which was usually associated to pressure forces (Lahmann & Kottner, 2011). Once again, this could also be an important (nursing) indicator that justifies the acquisition of supporting surfaces (to reduce the pressure), the utilization of assistive equipment (to assist patients and healthcare providers), the application of prophylactic dressings (with their specific characteristics), and/or (once again) the improvement of nurse-to-patient staffing ratios (to improve nursing care and, consequently, to reposition the patient during the shift more often).

However, we still face some problems related to wound classification. On one hand, the skin assessment tool proposed by the national guideline (DGS, 2011) does not comprise the category/stage “unstageable: depth unknown” and the category/stage “suspected deep

tissue injury: depth unknown" recommended by the international guidelines (NPUAP et al., 2014). On the other hand, our electronic health record template for wound classification does not include "incontinence-associated dermatitis" and "cutaneous breakage" which are essential to better understands the aetiology of some wounds/injuries.

Furthermore, there are some pressure ulcers (localised for example on the bridge of the nose, ear, occiput and malleolus), which are difficult to classify either as category/stage III, or category/stage IV due to the lack of body subcutaneous tissue on those areas.

Interestingly, (NPUAP, 2016) announces a change in terminology from "pressure ulcer" to "pressure injury", updates the stages of existent pressure injuries and suggests two additional pressure injuries definitions: "Medical Device Related Pressure Injury" and "Mucosal Membrane Pressure Injury".

PRESSURE ULCER ANATOMICAL LOCATION

The most problematic areas for the presence of pressure ulcer at the first pressure ulcer skin and tissue assessment in inpatient setting were the heels and the sacrum/coccyx (Sardo, Simões, Alvarelhão, Costa, et al., 2016).

Those anatomical locations had already been described as the most problematic areas by Ferreira et al. (2007) and Vanderwee, Clark, et al. (2007) in Portuguese hospitals. However, in some studies developed in other countries the pressure ulcers at sacrum/coccyx were in larger number (Igarashi et al., 2013; Mehta et al., 2015; Stevenson et al., 2013; Vanderwee, Clark, et al., 2007) regardless the care setting.

During the length of inpatient stay, the most problematic areas for pressure ulcer development were the sacrum/coccyx and trochanters (Sardo, Simões, Alvarelhão, Simões, Machado, et al., 2016).

The sacrum/coccyx had already been described as the most vulnerable area for pressure ulcer development during the length of stay in different care settings, such as intensive care units (Campanili et al., 2015; Cox, 2011; Manzano et al., 2010), long term facilities (Igarashi et al., 2013; Kwong et al., 2009) and general wards (Schoonhoven et al., 2007; Vanderwee, Clark, et al., 2007).

When we analyse the characteristics of the most frequent pressure ulcers anatomical locations (the heels, the sacrum/coccyx and the trochanters) we realise that they are areas with low body fat which increase the pressure on the skin between the bone and the contact surface.

Hyun et al. (2014), Uzun and Tan (2007) and Serra et al. (2013) already reported the influence of nutritional status and body mass index on pressure ulcer incidence.

Additionally, the sacrum/coccyx is an area usually exposed to moisture and changes in the natural skin surface pH (Sharp, White, Ousey, Butcher, & Iversen, 2012) due to the presence of urine and/or faeces in patients with different levels of dependence on self-care, which increase the odds of skin damage.

Sardo, Simões, Alvarelhão, Costa, et al. (2016) and Sardo, Simões, Alvarelhão, Simões, Machado, et al. (2016) also reported an important percentage of pressure ulcers in "other" locations. When we analyse our clinical practice, we realise that most of the pressure ulcer(s) that were recorded in "other" locations were due to the presence of medical devices (such as facial masks, drainage pips, monitoring cables and or immobilisation devices) that increased the pressure and friction and shear forces on those areas.

Thus, nurses should pay special attention on skin under and around medical devices and should inspect at least twice daily for the signs of pressure-related injury on the surrounding tissue, as international guidelines (NPUAP et al., 2014) preconized.

On the other hand, the skin assessment tool could be improved in order to better identify and record those "other" locations and the aetiology of those pressure ulcers.

PATIENTS CHARACTERISTICS'

The presence and/or development of pressure ulcer(s) is complex and multifactorial (Cox, 2011) and there are several pressure ulcer risk factors (Coleman, Nelson, et al., 2014; Coleman, Nixon, et al., 2014).

Using a univariate logistic regression model, Sardo, Simões, Alvarelhão, Costa, et al. (2016) showed that the highest odds of having a pressure ulcer at the first skin assessment in inpatient setting were significantly associated with advanced age, lower Braden Scale scores and/or Emergency Service admission.

According to Sardo, Simões, Alvarelhão, Simões, Machado, et al. (2016) the major risk factor for the development of a new pressure ulcer during the length of inpatient stay was the presence of (at least) one pressure ulcer at the first skin and tissue assessment. The length of stay itself, age and/or lower Braden Scale scores also played an important role in the odds of developing a pressure ulcer.

Those are very important epidemiological data that allow us to make a "profile" of the patients with highest odds of having and/or developing a pressure ulcer during the length of

stay. Although we are analysing non-modifiable risk factors, the knowledge of these patients' characteristics will allow us to identify some patients with higher risk and to plan more accurate nursing interventions, focused on their specific risk factors.

The presence of a pressure ulcer at the first skin assessment could be an important measure of frailty and the participants with pressure ulcer commonly had more than one documented pressure ulcer (Sardo, Simões, Alvarelhão, Costa, et al., 2016; Sardo, Simões, Alvarelhão, Simões, Machado, et al., 2016). When we analyse our clinical practice we realise that the presence of a pressure ulcer is not an isolated event. It is a part of a bigger problem and an important (nursing) indicator of patient global frailty. Those are very relevant data that show the importance of taking care of the person in a comprehensive and holistic way, in order to manage their specific problems and risk factors.

CAUSE OF HOSPITAL ADMISSION

Being admitted to a hospital is an important measure of frailty (Sardo, Simões, Alvarelhão, Simões, & Melo, 2016) and the cause of hospital admission could also be a significant variable on pressure ulcer risk, pressure ulcer prevalence and/or pressure ulcer incidence.

The participants with vascular diseases, traumatisms and fractures, respiratory diseases, infectious diseases or cardiac diseases were the ones with lower Braden Scale scores compared to the other participants with different ICD-9 diagnosis (Sardo et al., 2015).

The participants with respiratory diseases, infectious diseases and genitourinary system diseases were the ones with higher prevalence of pressure ulcer(s) at the first skin and tissue assessment compared to the other participants with different ICD-9 diagnosis (Sardo, Simões, Alvarelhão, Costa, et al., 2016).

The participants with infectious diseases, traumatism and fractures and respiratory diseases were the ones with higher incidence of pressure ulcer(s) during the length of inpatient stay compared to the other participants with different ICD-9 diagnosis (Sardo, Simões, Alvarelhão, Simões, Machado, et al., 2016).

In fact, cardiovascular diseases (Amir et al., 2011; Cox, 2011), traumatisms and fractures (Ham, Schoonhoven, Schuurmans, & Leenen, 2014; Iranmanesh, Rafiei, & Sabzevari, 2012) infections (Amir et al., 2011; Cox, 2011) and respiratory diseases (Amir et al., 2011; Tescher et al., 2012) had already been documented to be associated with patients' pressure ulcer risk, presence and/or development during the length of stay.

Once again, those are very important epidemiological data that allow us to identify (by the principal cause of admission in inpatient setting) the patients that are more likely to be at risk of, have and/or develop pressure ulcer(s) during the length of inpatient stay.

When we analyse our clinical practice, we realise that patients with cardiovascular diseases (like ischemic heart diseases and/or cerebrovascular diseases) need high periods of bedfast (namely in the first days of hospitalisation), but in several cases they preserve their ability to change and control body position.

In our reality, patients with respiratory diseases (such as acute respiratory infections, pneumonia and influenza and/or chronic obstructive pulmonary disease) and genitourinary diseases (for example chronic kidney diseases, acute kidney failure, infections of kidney and/or cystitis) were usually elderly with several comorbidities and significant dependence level on self-care.

On the other hand, patients with infectious diseases (specifically septicaemia, tuberculosis and/or erysipelas) and traumatism and fractures were usually victims of an unexpected event that causes multi-organic failure and/or immobility in bed and increases the odds of pressure ulcer development.

Patients with respiratory diseases have lower tissue oxygenation and perfusion (Bly, Schallom, Sona, & Klinkenberg, 2016; Senturan et al., 2009) and are usually positioned in supine with the head of the bed elevated (or sitting in rest chairs / armchairs) to optimise ventilator function. Thereby, there are changes in blood pH, some areas could have lack of oxygenation/perfusion and the position increases the pressure period in some areas (namely in the sacrum/coccyx).

DEVELOPMENT OF THE FISRT PRESSURE ULCER

According to Sardo, Guedes, Simões, Machado, and Melo (2016b), the participants that developed the first pressure ulcer during the length of inpatient stay differ from the ones that remain without pressure ulcers in the variables “admission”, “Braden Scale score”, “length of inpatient stay” and “age”. There were no differences between “gender” and “specialty units”.

Those are very important epidemiological data that show some non-modified risk factors that will contribute to plan and to implement more accurate preventive nursing interventions.

Additionally, the first week was particularly critical for pressure ulcer development and should be a period of highest nursing surveillance and preventive interventions (Sardo, Guedes, Simões, Machado, & Melo, 2016a).

In fact, more than a half of the first acquired pressure ulcers were developed in the first week of hospitalisation, and most of those participants developed their first pressure ulcer on day 5 of hospitalisation (Sardo et al., 2016a). Those data were particularly important because the median length of stay of the study population was 6 days (Q25=3days; Q75=10days) and the mean length of stay of the study population was 8 days.

As far as general wards were concerned, a study developed in two Netherland hospitals by Schoonhoven et al. (2007) showed that a considerable percentage of patients develop pressure ulcers during the first week of hospitalisation. Therefore, the period directly following admission should be considered critical for implementation of nursing preventive measures.

Other studies developed in intensive care units in USA (Cox, 2011) and in Brazil (Cremasco et al., 2013) also reported that the most vulnerable time for development of pressure ulcers during the length of stay was the first week, and highlighted that the first week of stay should be a period of higher vigilance for pressure ulcer risk (Cox, 2011). For Campanili et al. (2015), the major risk factor for pressure ulcer development in Brazilian ICU was the length of ICU stay for 9.5 days or more.

However, more studies are needed to better understand the correlation between time and pressure ulcer development.

Being admitted to a nursing home or a hospital is an important measure of frailty (Deandrea et al., 2013; Sardo, Simões, Alvarelhão, Simões, & Melo, 2016) and a prolonged length of stay is a significant predictor of functional decline during the hospitalisation (Hoogerduijn, Schuurmans, Duijnstee, de Rooij, & Grypdonck, 2007).

According to Theisen et al. (2012), the presence of a pressure ulcer during hospitalisation is an independent and significant predictor of a prolonged length of inpatient stay (for older patients). These results are consistent with other study reports (Graves, Birrell, & Whitby, 2005; Gunningberg & Stotts, 2008). Nevertheless, the impact of the hospital acquired pressure ulcers on length of inpatient stay was more evident when compared to the impact of the pressure ulcers already presented at admission (Theisen et al., 2012).

Although we need to reflect if it is the development of the pressure ulcer(s) that increases the patient frailty and, consequently, the length of inpatient stay ... Or if it is this patient global frailty and longer length of inpatient stay that leads to the development of the pressure ulcer(s) itself.

BRADEN SCALE ACCURACY TESTS

On chapter 5 we noticed that, as the total Braden Scale scores decreased, there was a statistically significant increase on the hazard of pressure ulcer development. However, there were some participants that were not classified as “at risk” of developing a pressure ulcer at the first pressure ulcer risk assessment that, effectively, developed a pressure ulcer during the length of inpatient stay.

In fact, due to the limited predictive power of the several risk assessment tools, many patients designated as “at risk” do not develop pressure ulcers (even when the preventive measures are omitted) and a considerable number of patients designated as “not at risk” do develop pressure ulcers (Vanderwee, Grypdonck, & Defloor, 2007).

According to Pancorbo-Hidalgo et al. (2006), the Braden Scale was tested in the largest number of studies and demonstrated the best reliability and validity indicators in different care settings.

However, some authors considered that the validity of Braden Scale effectiveness and accuracy was insufficient (Chou et al., 2013; Park, Choi, & Kang, 2015).

Indeed, Braden Scale sensitivity and specificity tests had a wide range depending on the research subjects and/or care settings (Chou et al., 2013) and the cut-off point used in clinical practice differed as well (Cowan, Stechmiller, Rowe, & Kairalla, 2012).

Our Braden Scale accuracy tests followed the international trend, with a sensitivity of 63.4% (CI 95%: 55.2% - 71.0%), specificity of 73.8% (CI 95%: 72.7% - 74.9%) and an area under the curve of 0.69 (CI 95%: 0.64 – 0.73). These results were inferior to the results presented by Park et al. (2015) in a systematic review about the predictive validity of Braden Scale for pressure ulcer risk in hospitalised patients. Our study was conducted in general wards (and not in specific services such as intensive care units) and some studies cited by Park et al. (2015) used a lower cut-off value to identify patients “at risk” of developing pressure ulcers, which may justify the differences reported.

Furthermore, some authors (Defloor & Grypdonck, 2004, 2005) reported that the use of effective preventive measures decreases the predictive value of the risk assessment scales.

Park et al. (2015) concluded that Braden Scale has a moderate predictive validity, which could be enhanced if it was applied differently according to the attributes of the study subjects.

As well as Braden (2012), we suggest that the total Braden Scale score should be used in combination with nursing clinical judgement in order to identify patients “at risk” of developing pressure ulcers. In addiction nurses should (also) use each Braden subscale as a guide to nursing interventions.

BRADEN SCALE AND NURSING JUDGMENT

The development of pressure ulcer(s) is complex and multifactorial (Cox, 2011) and nursing staff needs to manage several (modifiable and non-modifiable) risk factors in order to prevent pressure ulcer development.

According to Pancorbo-Hidalgo et al. (2006), the Braden Scale has better predictive validity than nursing judgement on its own, which depends on nursing experience. However, patients have additional risk factors and comorbidities not measured by the Braden Scale, and proper nursing judgment would reveal those risk factors and the need for a higher intensity of preventive nursing interventions (Braden, 2012).

Thus, when pressure ulcer risk assessment (using a validate tool like Braden Scale) is supplemented with good nursing judgment and reliably implemented interventions it is reasonable to expect that the incidence of full-thickness pressure ulcers will decrease (Braden, 2012; Sardo et al., 2015).

Using a univariate logistic regression model, Sardo et al. (2015) showed that lower Braden Scale scores were found in women, with longer length of inpatient stay, admitted in medical units, through emergency service and/or with advanced age. Those were very important epidemiological data that allowed us to identify some characteristics of the participants with higher risk of pressure ulcer development (Braden Scale score ≤ 16).

According to Sardo et al. (2015), (in)“activity”, (im)“mobility” and the “friction/shear forces” problems had a higher contribution to the total Braden Scale score. Those are different dimensions assessed through Braden Scale that could (and should) be managed by nursing staff during the length of stay in order to reduce the pressure ulcer risk and, consequently, the pressure ulcer development.

The multivariate time to event analysis (presented in chapter 5) showed that (im)“mobility” was the major risk factor (assessed through Braden Scale) for pressure ulcer development during the length of inpatient stay, for all participants, independently of the total Braden Scale score. So, the greatest efforts in managing pressure ulcer (risk) development should be on “mobility” (the patient ability to change and control body position), independently of the total Braden Scale score.

When we analyse our clinical practice, we realise that the greatest efforts in managing pressure ulcer (risk) development should be on patients with some level of dependence on self-positioning and self-transferring. These patients usually have lower ability to change and control body position and limited degree of physical activity. They require different levels of assistance during the body repositioning with highest odds of the presence of friction and shear forces. They also have (in several cases) lower peripheral sensory perception.

NUTRITIONAL RISK ASSESSMENT

The low correlations between "nutrition" subscale score and the total Braden Scale score may indicate that nutritional risk as not been accessed objectively in Aveiro Hospital (Sardo et al., 2015).

The univariate time to event analysis (presented in chapter 5), showed that all Braden subscales, except "nutrition", were associated with the development of pressure ulcer during the length of inpatient stay.

Cox (2011), Tescher et al. (2012) and Sardo et al. (2015) reported that "nutrition" was not a significant predictor of pressure ulcers in intensive care units and/or general wards. However, nutrition or poor nutrition is a factor that predisposes the pressure ulcer(s) development (Sharp & McLaws 2006). Some authors reported that patients with lower albumin levels (Anthony et al. 2000, Uzun &Tan 2007, Serra et al. 2013) and/or lower body mass index (Uzun & Tan 2007, Serra et al. 2013) have higher risk for pressure ulcer development. Thus, the low hazard ratio between "nutrition" subscale and the incidence of participants with pressure ulcers during the length of inpatient stay may indicate that nutritional risk has not been accessed objectively (Sharp & McLaws 2006).

Several authors (Posthauer, Banks, Dorner, & Schols, 2015; Serpa & Santos, 2014) highlighted the importance of nutrition on pressure ulcer prevention and/or treatment. So, we suggest the adoption of NPUAP et al. (2014) recommendations for nutritional risk assessment and the adoption of a nutritional risk assessment tool that besides documentation of food and fluid intakes should include anthropometrics evaluations and (ideally) biochemical data.

CONCLUSION

In this chapter we discussed some issues related to nursing assessment, namely pressure ulcer risk assessment, Sand tissue assessment and nutritional risk assessment.

We highlighted the prevalence and the incidence of participants with pressure ulcer(s) and analysed the pressure ulcer category/stage, the pressure ulcer anatomical location and some patient characteristics' that increased the odds of having a pressure ulcer at admission and/or developing a pressure ulcer during the length of stay.

We realised that the first week was particularly critical for pressure ulcer development and should be a period of highest surveillance and preventive interventions. However, more studies are needed to better understand the correlation between pressure ulcer development and length of inpatient stay.

We analysed our Braden Scale accuracy tests and the need of combine Braden Scale scores with proper nursing judgment in order to plan and implement more accurate nursing interventions.

During the discussion we compared our results with previous evidence studies, described our reality and suggested some substantiated changes in order to improve clinical practice and clinical research.

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CONCLUSIONS AND IMPLICATIONS

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CONCLUSIONS AND IMPLICATIONS

Pressure ulcers continue to be a challenge (Dealey et al., 2013; DGS, 2011; NPUAP, EPUAP, & PPPIA, 2014; Rodrigues, Ferre-Grau, & Ferreira, 2015) to all health care professionals and institutions and preventive strategies should (still) be discussed in a multidisciplinary way in order to improve patients' outcomes (Sardo, Guedes, Alvarelhão, et al., 2016; Sardo, Guedes, Simões, Machado, & Melo, 2016a, 2016b; Sardo et al., 2015; Sardo, Simões, Alvarelhão, Costa, et al., 2016; Sardo, Simões, Alvarelhão, Simões, & Melo, 2014; Sardo, Simões, Alvarelhão, Simões, et al., 2016).

There are several studies focus on the magnitude of pressure ulcers problem. However, each study has a specific methodological design and provides a specific "point of view". In fact, each "photograph" highlights different faces of the problem and allowed us to better understand their complexity.

This Thesis was performed considering national (DGS, 2011) and international (NPUAP et al., 2014) guidelines and analysed the characteristics of the patients with higher risk of pressure ulcer development at admission and during the length of stay; the characteristics of the patients that already had a pressure ulcer at admission in inpatient setting; the characteristics of the patients that developed a pressure ulcer during the length of inpatient stay; and the influence of some modifiable and non-modifiable risk factors (with special attention on the risk factors assessed by Braden Scale) on pressure ulcer risk, prevalence and incidence.

Approximately one third of all participants had high risk of pressure ulcer development at admission in inpatient setting. The Braden Scale scores significantly increased in the last assessments showing that Braden Scale is sensitive to the clinical improvement of the patient. However, there were some participants that were transferred to other healthcare institution and/or discharged that still had high risk of pressure ulcer development.

Following EPUAP statement (Defloor et al., 2005) we reported a point prevalence of 7.9% participants with pressure ulcer at the first skin assessment in inpatient setting, a period prevalence of 10.0% participants with pressure ulcer in inpatient setting during 2012, and a cumulative incidence of 3.4% participants with pressure ulcer in inpatient setting during the same period.

Considering the category/stage I to IV, 1775 pressure ulcers were recorded in medical and surgical wards of Aveiro Hospital during 2012. Most of the pressure ulcers recorded were category/stage I. The heels, the sacrum/coccyx and the trochanters were the most critical anatomical locations.

The presence of a pressure ulcer at the first skin assessment is an important measure of frailty. The participants with pressure ulcer commonly had more than one documented pressure ulcer and highest odds of developing a new one during the length of stay.

Our Braden Scale accuracy tests showed a sensitivity of 63.4% (CI 95%: 55.2%-71.0%), a specificity of 73.8% (CI 95%: 72.7%-74.9%) and an area under the curve of 0.69 (CI 95%: 0.64-0.73).

The lack of ability to change and control body position (immobility) was the major risk factor (assessed through Braden Scale) for pressure ulcer development during the length of stay, for all participants, independently of the Braden Scale score.

However, there are important pressure ulcer risk factors not assessed by Braden Scale such as age, the cause and type of admission, the length of inpatient stay and the presence of a pressure ulcer that should be considered by nurses when they plan and deliver care.

In fact, the awareness of the existence of modifiable and non-modifiable risk factors and the influence of Braden subscale scores could contribute to improve nursing care and patients' outcomes.

A previous national survey concluded that most pressure ulcers could be avoided if the preventive measures were implemented based on (the best) scientific evidence (Ferreira, Miguéns, Gouveia, & Furtado, 2007). We believe that our results were important to improve the knowledge on the magnitude of pressure ulcers problem in general wards (based on our own reality) and provided important implications to clinical practice, clinical research, clinical management and continuous education.

During the development of this Thesis we participated in several scientific events and share our results through the publication of original articles, abstracts and oral and poster presentations (Appendix 1).

We have several studies in project. However, in (a near) future we aim to develop, implement and evaluate a preventive protocol based on national and international guidelines, institutional reality, patients' clinical and demographic characteristics and affected Braden subscales.

Limitations

These studies (Sardo, Guedes, Alvarelhão, et al., 2016; Sardo, Guedes, et al., 2016a, 2016b; Sardo et al., 2015; Sardo, Simões, Alvarelhão, Costa, et al., 2016; Sardo et al., 2014; Sardo, Simões, Alvarelhão, Simões, et al., 2016) were designed as a retrospective cohort analysis of electronic health record database and some limitations were due to data record and database characteristics.

We were focused on the magnitude of pressure ulcer(s) problem in general wards and we analysed the data that were effectively recorded. We were not focused on the compliance with prevention guidelines/protocols and/or on nursing records reliability.

These studies (Sardo et al., 2015; Sardo, Simões, Alvarelhão, Costa, et al., 2016; Sardo, Simões, Alvarelhão, Simões, et al., 2016) allowed us to find some limitations in hospital database and we are already working with Nursing Board, Informatics and Systems Analysis Service and Nursing Staff to upgrade nursing assessment documentation, nursing interventions documentation and hospital database.

At Aveiro Hospital the pressure ulcer risk assessment and skin and tissue assessment has been performed in a systematic way in medical and surgical wards since 2012. Regular audits to the nursing records have been performed since then and the results are communicated to nursing staff periodically in order to improve data record. However, pressure ulcer risk assessment, skin and tissue assessment and nursing records audits did not happen in emergency service and our data only showed the risk, the prevalence and incidence in inpatient settings.

There is no formal protocol in Aveiro Hospital related to the implementation (and documentation) of preventive interventions/measures and we were not able to discuss if those interventions were (or were not) correctly implemented.

There is lack of documentation related to pressure ulcer characteristics and our data only showed the pressure ulcer category/stage and anatomical location.

Using some methodological designs we were not able to perform a multivariate analysis, which limits the evaluation of the associated factors with the development of a pressure ulcer during the length of inpatient stay.

We are aware that there are important risk factors that could be collected with different methodological designs, with different clinical and research tools.

Based on these limitations we have already performed a prevalence study with new clinical and research tools which the results will allow us to analyse co-morbidities, dependence level, therapeutics, anthropometric, physiological and/or biochemical data of our patients, as well as nursing preventive interventions and pressure ulcer characteristics.

Implications to clinical practice, clinical research, clinical management and continuous education

The systematic pressure ulcer risk assessment creates a set of (nursing) indicators and identifies patients with higher risk of pressure ulcer development.

The systematic pressure ulcer risk assessment through Braden Scale identifies changes in the patient condition during the length of stay.

The total Braden Scale score should be used in combination with nursing clinical judgement in order to identify patients with higher risk of pressure ulcer development.

There are several (modifiable and non-modifiable) pressure ulcer risk factors not assessed by Braden Scale.

Nursing interventions should be planned and implemented according to the risk level identified and according to the patients' specific (modifiable and non-modifiable) risk factors.

Each Braden subscale should be used as a guide to plan more accurate nursing interventions.

The lack of ability to change and control body position was the major risk factor (assessed through Braden Scale) for pressure ulcer development during the length of stay, independently of the total Braden Scale score.

The first week was particularly critical for pressure ulcer development and should be a period of highest nursing surveillance and preventive interventions.

The systematic skin and tissue assessment creates a set of (nursing) indicators and contributes to prevalence and incidence rates analyses.

The systematic skin and tissue assessment identifies early changes in skin and tissue status.

The Skin Assessment Tool could be optimised with the inclusion of all pressure ulcer categories/stages preconized by international guidelines.

The Skin Assessment Tool could be optimised in order to record different wounds of different aetiologies.

The Skin Assessment Tool template should have a place to describe/identify the anatomical location “others” and/or the wound aetiologies.

The pressure ulcer assessment could be improved with the implementation of a validated tool to monitor pressure ulcers characteristics and their evolution during the length of stay.

The nutritional assessment could be improved with the implementation of a validated tool to monitor the nutritional status during the length of stay. The international guidelines for pressure ulcer prevention and treatment proposed the application of a nutritional risk assessment tool that besides documentation of food and fluid intakes should include anthropometrics evaluations and (ideally) biochemical data.

Clinical practice should be based on scientific evidence. The documentation of nursing assessment, nursing interventions and nursing outcomes is essential to promote the evidence-based nursing, compare data between services and/or between different periods.

The systematic pressure ulcer risk assessment and the systematic skin and tissue assessment should be performed since the hospital admission and should be implemented in emergency service.

Pressure ulcer(s) problem is complex and multifactorial. So, pressure ulcer management should (also) be multidisciplinary. Each Science offers different “points of view” of the magnitude of pressure ulcers problem and provides different theoretical contributions and different technical skills to reduce (and ideally) solve it.

The undergraduate and graduate students are key elements in research projects and could be the main link between the universities and the health care institutions.

The clinical nurses are vital to the success of any clinical research. They know their institutional reality and should be involved in the clinical research process.

This study could (and should) be replicated in different care settings like intensive care units, long-term care units and/or nursing homes.

The results could (and should) be analysed by the Hospital Council Board and could justify the acquisition of supporting surfaces, assistive equipment, repositioning equipment, prophylactic dressings and/or the improvement of nurse-to-patient staffing ratios.

The results could (and should) be analysed and discussed in a multidisciplinary way in order to improve clinical practice and patients' outcomes.

The upgrade and/or the implementation of new assessment tools should be preceded by a training period and followed by continuous education and periodic audits to identify and correct possible problems and optimise the entire process.

The interaction between the hospital and other care settings and/or home care is essential to improve continuous care. The informal caregivers and the patients themselves are key elements on that empowerment process.

Universities and health care institutions should work together to promote the bidirectional link between theory and practice; to find answers to clinical problems; to create relations between clinical research and clinical practice; and to involve undergraduate and graduate students in research projects.

On-going and future projects

During the development of this project we found some limitations in hospital database and we are already working in order to upgrade nursing assessment documentation, nursing interventions documentation and hospital database.

The creation of a working group composed by registered nurses and clinical nurses specialists from different departments and health researchers will allow the development of a preventive protocol based on international guidelines, institutional reality, patients' characteristics and affected Braden subscales. This protocol could be implemented in different departments, and will guide nursing staff planning and applying preventive interventions.

We already performed a prevalence study with new clinical and research tools which the results will allow us to analyse co-morbidities, dependence level, therapeutics, anthropometric, physiological and/or biochemical data of our patients, as well as nursing preventive interventions and pressure ulcer characteristics. This study was developed on the same day in 3 different hospitals with the participation of researchers from University of Aveiro, nursing teams and nursing students that were developing their clinical practice in different services.

We are collaborated with “Centro de Estudos e Investigação em Saúde da Universidade de Coimbra” (CEISUC) on the validation process of the Portuguese version of Bates-Jensen Wound Assessment Tool (BWAT).

We created an important network with other professionals, associations and health care institutions and from 2017 we will aim to perform new epidemiological studies in emergency services, intensive care units, long-term care units and/or in nursing homes.

There are several national (Associação Portuguesa de Tratamento de Feridas; ELCOS Sociedade de Feridas; Grupo Associativo de Investigação em Feridas; …) and international (European Pressure Ulcer Advisory Panel; European Wound Management Association Grupo de Estudio de Heridas y Úlceras por Presión; National Pressure Ulcer Advisory Panel; Pan Pacific Pressure Injury Alliance; Sociedad Iberolatinoamericana Úlceras y Heridas; Tissue Viability Society…) organizations that promote the discussion about the magnitude of pressure ulcers problem and we aim to (still) present our results in scientific events and/or in scientific journals.

Final disclosure

In 2016, National Pressure Ulcer Advisory Panel (NPUAP, 2016) announces a change in terminology from “pressure ulcer” to “pressure injury” and updates the stages of pressure injury. The updated staging system suggests the following definitions:

Pressure Injury: A pressure injury is localized damage to the skin and/or underlying soft tissue usually over a bony prominence or related to a medical or other device. The injury can present as intact skin or an open ulcer and may be painful. The injury occurs as a result of intense and/or prolonged pressure or pressure in combination with shear. The tolerance of soft tissue for pressure and shear may also be affected by microclimate, nutrition, perfusion, co-morbidities and condition of the soft tissue (NPUAP, 2016).

Stage 1 Pressure Injury (Non-blanchable erythema of intact skin): Intact skin with a localized area of non-blanchable erythema, which may appear differently in darkly pigmented skin. Presence of blanchable erythema or changes in sensation, temperature, or firmness may precede visual changes. Colour changes do not include purple or maroon discoloration; these may indicate deep tissue pressure injury (NPUAP, 2016).

Stage 2 Pressure Injury (Partial-thickness skin loss with exposed dermis): Partial-thickness loss of skin with exposed dermis. The wound bed is viable, pink or red, moist, and may also present as an intact or ruptured serum-filled blister. Adipose (fat) is not visible and

deeper tissues are not visible. Granulation tissue, slough and eschar are not present. These injuries commonly result from adverse microclimate and shear in the skin over the pelvis and shear in the heel. This stage should not be used to describe moisture associated skin damage (MASD) including incontinence associated dermatitis (IAD), intertriginous dermatitis (ITD), medical adhesive related skin injury (MARSI), or traumatic wounds (skin tears, burns, abrasions) (NPUAP, 2016).

Stage 3 Pressure Injury (Full-thickness skin loss): Full-thickness loss of skin, in which adipose (fat) is visible in the ulcer and granulation tissue and epibole (rolled wound edges) are often present. Slough and/or eschar may be visible. The depth of tissue damage varies by anatomical location; areas of significant adiposity can develop deep wounds. Undermining and tunneling may occur. Fascia, muscle, tendon, ligament, cartilage and/or bone are not exposed. If slough or eschar obscures the extent of tissue loss this is an Unstageable Pressure Injury (NPUAP, 2016).

Stage 4 Pressure Injury (Full-thickness skin and tissue loss): Full-thickness skin and tissue loss with exposed or directly palpable fascia, muscle, tendon, ligament, cartilage or bone in the ulcer. Slough and/or eschar may be visible. Epibole (rolled edges), undermining and/or tunneling often occur. Depth varies by anatomical location. If slough or eschar obscures the extent of tissue loss this is an Unstageable Pressure Injury (NPUAP, 2016).

Unstageable Pressure Injury (Obscured full-thickness skin and tissue loss): Full-thickness skin and tissue loss in which the extent of tissue damage within the ulcer cannot be confirmed because it is obscured by slough or eschar. If slough or eschar is removed, a Stage 3 or Stage 4 pressure injury will be revealed. Stable eschar (i.e. dry, adherent, intact without erythema or fluctuance) on the heel or ischemic limb should not be softened or removed (NPUAP, 2016).

Deep Tissue Pressure Injury (Persistent non-blanchable deep red, maroon or purple discoloration): Intact or non-intact skin with localized area of persistent non-blanchable deep red, maroon, purple discoloration or epidermal separation revealing a dark wound bed or blood filled blister. Pain and temperature change often precede skin color changes. Discoloration may appear differently in darkly pigmented skin. This injury results from intense and/or prolonged pressure and shear forces at the bone-muscle interface. The wound may evolve rapidly to reveal the actual extent of tissue injury, or may resolve without tissue loss. If necrotic tissue, subcutaneous tissue, granulation tissue, fascia, muscle or other underlying structures are visible, this indicates a full thickness pressure injury (Unstageable, Stage 3 or Stage 4). Do not use DTPI to describe vascular, traumatic, neuropathic, or dermatologic conditions (NPUAP, 2016).

Furthermore, NPUAP (2016) proposes **additional pressure injury definitions** such as:

Medical Device Related Pressure Injury: This describes aetiology. Medical device related pressure injuries result from the use of devices designed and applied for diagnostic or therapeutic purposes. The resultant pressure injury generally conforms to the pattern or shape of the device. The injury should be staged using the staging system (NPUAP, 2016).

Mucosal Membrane Pressure Injury: Mucosal membrane pressure injury is found on mucous membranes with a history of a medical device in use at the location of the injury. Due to the anatomy of the tissue these injuries cannot be staged (NPUAP, 2016).

Although our results were consistent with the need of improve wounds classification, this new terminology was not applied in our study reports.

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APPENDICES AND ATTACHMENTS

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APPENDICES AND ATTACHMENTS

APPENDIX 1 – THESIS DEVELOPMENT (TIMELINE)

ATTACH 1 – PORTUGUESE VERSION OF BRADEN SCALE

(Escala de Braden para Avaliação do Risco de Úlceras de Pressão)

ATTACH 2 – SKIN ASSESSMENT TOOL

(Instrumento da Avaliação da Pele)

ATTACH 3 – HOSPITAL COUNCIL BOARD AND ETHICS COMMITTEE APPROVAL

(Parecer Conselho de Administração e da Comissão de Ética do Hospital)

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APPENDIX 1

THESIS DEVELOPMENT (TIMELINE)

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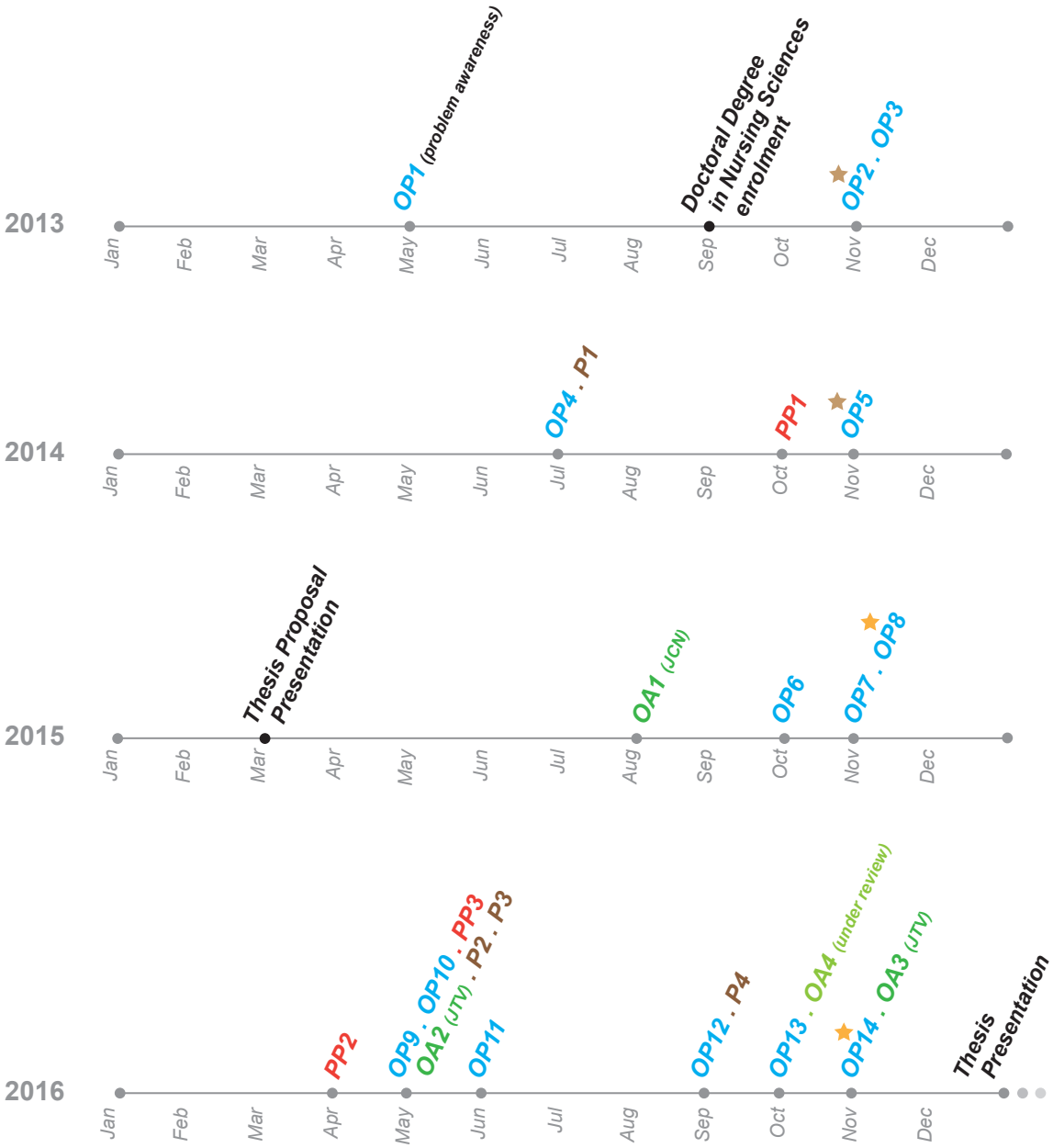
Thesis Development (Timeline)



Original Articles (in Indexing Journals)

OA1 - Pressure ulcer risk (JCN)
OA2 - Pressure ulcer prevalance (JTV)
OA3 - Pressure ulcer incidence (JTV)
OA4 - Braden Subscales (under review)

Proceedings (in Indexing Journals)

P1 - Revista de Enfermagem Referência
P2 - BMC Health Services Research
P3 - BMC Health Services Research
P4 - Atención Primaria

Poster Presentations (in Scientific Events)

PP1 - VII Encontro de Doutorandos em CE
PP2 - 1ªsJornadas Internacionais de Saúde da ESSUA
PP3 - 3º Congresso Internacional de Saúde do IPLeiria

Oral Presentations (in Scientific Events)

OP1 - II Jornadas Internacionais...
OP2 / OP3 - APTFeridas 2013
OP4 - X Conferência da OMS...
OP5 - APTFeridas 2014
OP6 - VIII Encontro de Doutorandos em CE
OP7 / OP8 - APTFeridas 2015
OP9 - IX Congresso Iberolatinoamericano...
OP10 - 3º Congresso Internacional de Saúde do IPLeiria
OP11 - CINTESIS-ESEP: I+I&D
OP12 - 3rd World Congress of Health Research
OP13 - IX Encontro de Doutorandos em CE
OP14 - APTFeridas 2016

★ 1st award ★ 3rd award

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ATTACH 1

PORTUGUESE VERSION OF BRADEN SCALE

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ESCALA DE BRADEN PARA AVALIAÇÃO DO RISCO DE ÚLCERAS DE PRESSÃO

Nome do doente: _____ **Nome do avaliador:** _____ **Data da avaliação:**

Serviço: _____ **Cama:** _____ **Idade:** _____

Percepção sensorial Capacidade de reacção significativa ao desconforto	**1. Completamente limitada**: Não reage a estímulos dolorosos (não geme, não se retrai nem se agarra a nada) devido a um nível reduzido de consciência ou à sedação, OU capacidade limitada de sentir a dor na maior parte do seu corpo.	**2. Muito limitada:** Reage unicamente a estímulos dolorosos. Não consegue comunicar o desconforto, excepto através de gemidos ou inquietação, OU tem uma limitação sensorial que lhe reduz a capacidade de sentir dor ou desconforto em mais de metade do corpo.	**3. Ligeiramente limitada:** Obedece a instruções verbais, mas nem sempre consegue comunicar o desconforto ou a necessidade de ser mudado de posição, OU tem alguma limitação sensorial que lhe reduz a capacidade de sentir dor ou desconforto em 1 ou 2 extremidades.	**4. Nenhuma limitação:** Obedece a instruções verbais. Não apresenta défice sensorial que possa limitar a capacidade de sentir ou exprimir dor ou desconforto.						
Humidade Nível de exposição da pele à humidade	**1. Pele constantemente húmida**: A pele mantém-se sempre húmida devido a sudorese, urina, etc. É detectada humidade sempre que o doente é deslocado ou virado.	**2. Pele muito húmida:** A pele está frequentemente, mas nem sempre, húmida. Os lençóis têm de ser mudados pelo menos uma vez por turno.	**3. Pele ocasionalmente húmida:** A pele está por vezes húmida, exigindo uma muda adicional de lençóis aproximadamente uma vez por dia.	**4. Pele raramente húmida:** A pele está geralmente seca; os lençóis só têm de ser mudados nos intervalos habituais.						
Actividade Nível de actividade física	**1. Acamado**: O doente está confinado à cama.	**2. Sentado**: Capacidade de marcha gravemente limitada ou inexistente. Não pode fazer carga e/ou tem de ser ajudado a sentar-se na cadeira normal ou de rodas.	**3. Anda ocasionalmente:** Por vezes caminha durante o dia, mas apenas curtas distâncias, com ou sem ajuda. Passa a maior parte dos turnos deitado ou sentado.	**4. Anda frequentemente:** Anda fora do quarto pelo menos duas vezes por dia, e dentro do quarto pelo menos de duas em duas horas durante o período em que está acordado.						
Mobilidade Capacidade de alterar e controlar a posição do corpo	**1. Completamente imobilizado**: Não faz qualquer movimento com o corpo ou extremidades sem ajuda.	**2. Muito limitada**: Ocasionalmente muda ligeiramente a posição do corpo ou das extremidades, mas não é capaz de fazer mudanças frequentes ou significativas sozinho.	**3. Ligeiramente limitado:** Faz pequenas e frequentes alterações de posição do corpo e das extremidades sem ajuda.	**4. Nenhuma limitação:** Faz grandes ou frequentes alterações de posição do corpo sem ajuda.						
Nutrição Alimentação habitual	**1. Muito pobre:** Nunca come uma refeição completa. Raramente come mais de 1/3 da comida que lhe é oferecida. Come diariamente duas refeições, ou menos, de proteínas (carne ou lacticínios). Ingere poucos líquidos. Não toma um suplemento dietético líquido OU está em jejum e/ou a dieta líquida ou a soros durante mais de cinco dias.	**2. Provavelmente inadequada:** Raramente come uma refeição completa e geralmente come apenas cerca de 1/2 da comida que lhe é oferecida. A ingestão de proteínas consiste unicamente em três refeições diárias de carne ou lacticínios. Ocasionalmente toma um suplemento dietético OU recebe menos do que a quantidade ideal de líquidos ou alimentos por sonda.	**3. Adequada:** Come mais de metade da maior parte das refeições. Faz quatro refeições diárias de proteínas (carne, peixe, lacticínios). Por vezes recusa uma refeição, mas toma geralmente um suplemento caso lhe seja oferecido, OU é alimentado por sonda ou num regime de nutrição parentérica total satisfazendo provavelmente a maior parte das necessidades nutricionais.	**4. Excelente:** Come a maior parte das refeições na íntegra. Nunca recusa uma refeição. Faz geralmente um total de quatro ou mais refeições (carne, peixe, lacticínios). Come ocasional-mente entre as refeições. Não requer suplementos.						
Fricção e forças de deslizamento	**1. Problema:** Requer uma ajuda moderada a máxima para se movimentar. É impossível levantar o doente completamente sem deslizar contra os lençóis. Descai frequentemente na cama ou cadeira, exigindo um reposicionamento constante com ajuda máxima. Espasticidade, contraturas ou agitação leva a fricção quase constante.	**2. Problema potencial:** Movimenta-se com alguma dificuldade ou requer uma ajuda mínima. É provável que, durante uma movimentação, a pele deslize de alguma forma contra os lençóis, cadeira, apoios ou outros dispositivos. A maior parte do tempo, mantém uma posição relativamente boa na cama ou na cadeira, mas ocasionalmente descai.	**3. Nenhum problema:** Move-se na cama e na cadeira sem ajuda e tem força muscular suficiente para se levantar completamente durante uma mudança de posição. Mantém uma correcta posição na cama ou cadeira.							
Nota: Quanto mais baixa for a pontuação, maior será o potencial para desenvolver uma úlcera de pressão.				**Pontuação total**						

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ATTACH 2

SKIN ASSESSMENT TOOL

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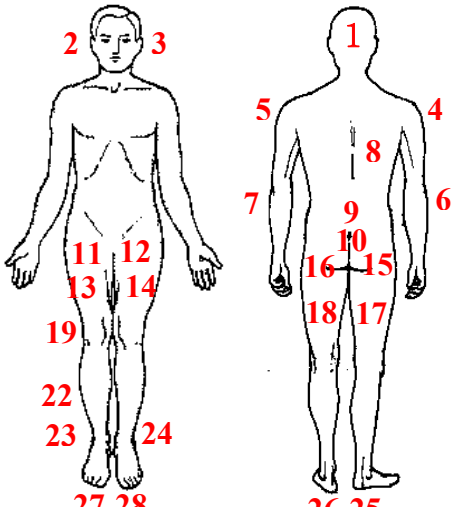
INSTRUMENTO DE AVALIAÇÃO DA PELE

Nome_____ Idade _____ Serviço _____

Data da observação ____ / ____ /____

Local avaliado	Tamanho	Condição da pele Profundidade	Estadío
1. Face posterior da cabeça			
2. Orelha direita			
3. Orelha esquerda			
4. Ombro direito			
5. Ombro esquerdo			
6. Cotovelo direito			
7. Cotovelo esquerdo			
8. Vértebras (superior médio)			
9. Sacro			
10. Cóccis			
11. Crista ilíaca direita			
12. Crista ilíaca esquerda			
13. Trocanter direito (anca)			
14. Trocanter esquerdo (anca)			
15. Tuberosidade iaquiática direita			
16. Tuberosidade isquiática esquerda			
17. Coxa direita			
18. Coxa esquerda			
19. Joelho direito			
20. Joelho esquerdo			
21. Perna direita			
22. Perna esquerda			
23. Tornozelo direito			
24. Tornozelo esquerdo			
25. Calcanhar direito			
26. Calcanhar esquerdo			
27. Dedos do pé direito			
28. Dedos do pé esquerdo			
29. Outro (especificar)			



Grau I – Eritema cutâneo / hiperémia não reversível ao alívio da pressão; percursor da ulceração da pele.

Grau II – Perda parcial da espessura da pele que pode afectar a epiderme e/ou a derme. A úlcera é uma lesão superficial que pode ter aspecto de escoriação, flictena ou pequena cratera.

Grau III – Perda total da pele com lesão ou necrose do tecido subcutâneo, podendo estender-se mais e afectar a camada subadjacente.

Grau IV – Lesão em toda a espessura da pele com destruição massiva, necrose tecidular ou danos musculares, ósseos ou de elementos de suporte (tendões, cápsula articular, etc.). Estas lesões podem apresentar trajectos sinuosos e socavados.

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ATTACH 3

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AND ETHICS COMMITTEE APPROVAL

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Director da Escola Superior de Saúde
da Universidade de Aveiro
Escola Sup. Saúde da U.A.
Campus Univ. Santiago, ed. III
3810-193 Aveiro

S/ Ref.ª	*S/ Comunicação de*	*N/ Ref.ª*	*Aveiro,*
		049688	**16-01-2014**

ASSUNTO: Pedido de autorização para elaboração de Projeto de Investigação "Avaliação das Úlceras de Pressão e Pé Diabético em Utentes Hospitalizados.

Na sequência do ofício de V.Exa., sobre o assunto em epígrafe, informa-se que está autorizado.

Junta-se em anexo, a informação dada pela Comissão de Ética.

Atenciosamente e com os melhores cumprimentos,

O Presidente do Conselho de Administração

((José Afonso)

GM.

10-07-2013

EXMO CONSELHO DE ADMINISTRAÇÃO

DO

CENTRO HOSPITALAR DO BAIXO VOUGA EPE.

A Comissão de Ética reuniu no dia 20 de Novembro de 2013, com todos os seus elementos.
Analisou um pedido de "Projecto de Investigação-Avaliação das Úlceras de Pressão e de Pé Diabético em Utentes Hospitalizados", formulado por uma equipa docente da Escola Superior de Saúde da Universidade de Aveiro, com a colaboração dos Serviços de Cirurgia Geral e de Patologia, bem como dos Departamentos Cirúrgico e Médico do Centro Hospitalar, para avaliar a epidemiologia das úlceras de pressão bem como entre outros factores, as alterações genéticas em microorganismos multirresistentes a pesquisar nas ditas úlceras. A Enfermeira Drª Elsa Melo da equipa da Universidade, deu na reunião todas as explicações pedidas.
A Comissão de Ética entende que estão cumpridos os princípios éticos com as devidas autorizações e consentimento para a colheita de dados, e que lhe parecem de interesse científico as motivações do estudo genético a elaborar na Universidade, pelo que é de entendimento não haver impedimento à satisfação do pretendido

Respeitosos cumprimentos

Aveiro, 20 de Novembro de 2013

Pela Comissão de Ética

Amorim Figueiredo
(Presidente)

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